St. James the Great Roman Catholic Primary and Nursery School

Written Calculations Policy

Date Created: Summer 2010
Date Reviewed: Spring 2015

Guidance to support the teaching of written calculations

We aim to ensure that by the end of year 6 most children will understand and use successfully compact written methods to carry out and record calculations that they cannot do in their heads.

To enable children to move towards compact written methods with full understanding, a step by step approach is taken. For each of the four operations children are first introduced to expanded methods that lead to a compact form of calculation. It is important that children feel secure and comfortable with each stage towards compact methods before they move on to the next. Children will progress through the stages of expanded calculations at different rates. It is far better that they can operate efficiently at any stage and with understanding than to move them on too quickly. Not all children will reach compact methods by the end of year 6.

Approach

The children need to approach any calculation by asking themselves the following questions:

- Can I do this in my head?
- Do I know the approximate size of the answer?
- If I cannot do it wholly in my head what do I need to write down in order to help me calculate the answer?
- Will the written method I know be helpful?

When considering more complex calculations, that they could not easily perform using pencil and paper procedures, they will also need to consider:

- Would it be more useful to use a calculator to work this out?

However, it is important to note that the National Curriculum emphasises the importance of fluency in mental calculations and a confident understanding of compact written methods for all four operations, over the use of a calculator. This is reflected in the new testing arrangements for mathematics in primary schools, as calculators are no longer permitted in the national tests for mathematics.

Whenever appropriate the children should do mental calculations. In order to support this approach calculations are usually presented to children horizontally so they can make decisions as to the best way to solve the problem.

Addition and Subtraction

Criteria, which would indicate a child's readiness for formal written methods of addition and subtraction, would include:

- Knowledge of addition and subtraction facts to 20.
- Understanding of place value and ability to partition numbers into hundreds, tens and units.
- Understanding of commutative and associative laws of addition (though not of these terms).
- Ability to add at least three single digit numbers mentally.
- Ability to explain mental strategies, orally, pictorially, and in writing.
- Ability to understand and use pictorial or diagrammatic representations of addition and subtraction calculations, for example:

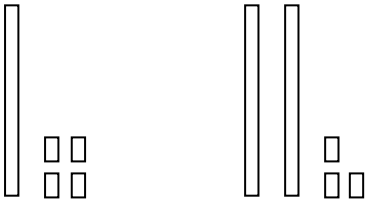
3 + 4 =

☆ ☆ ☆ + ☆ ☆ ☆ ☆ =

9 – 4 =

~~☆ ☆ ☆ ☆~~ ☆ ☆ ☆ ☆ ☆ =

14 + 23 =



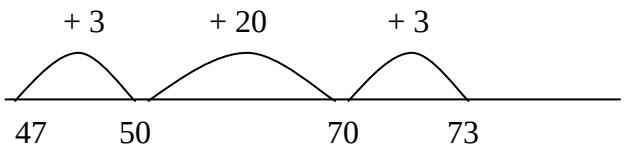
Progression in Addition

The following stages show a progression from informal written methods for addition leading to a compact method.

Stage 1

Numbers of varying size using an empty (blank) number line

47 + 26



Stage 2

Using Partitioning, adding the least significant digit first (in this example this is the units).

47 + 76

```
  7  +  6
 40 +  70
-------
```

13 + 110 = 123

Stage 3

Expanded vertical layout of a calculation showing the addition of the units and tens separately. Record the least significant digit first. Children should become fluent with adding 2 and 3 digit numbers before progressing to the next stage.

```
  47
+ 76
----
  13
 110
----
 123
```

Stage 4

Introduce the compact layout alongside the expanded format. Introduce calculations that involve one 'carry'. The position of the 'carried' digit can be either written below the calculation as in this example, or can be written above the calculation, in the appropriate column.

```
  47
+ 76
----
  13
 110
----
 123
```

```
  47
+ 76
----
 123
  1
```

Stage 5

Introduce calculations that involve more than one 'carry'.

```
   47
+  76
----
  123
  1 1
```

Stage 6

Use these layouts with bigger numbers and decimals. Children may need to revert to more expanded layouts initially.

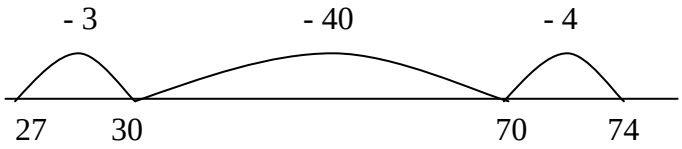
Progression in Subtraction

Stage 1

Using an empty number line. In order to consolidate the child's understanding of the concept of subtraction the calculation should be started at 74 (on the far side of the empty number line), then subtraction occurs in the jumps as shown.

Children who have a secure understanding of subtraction as the difference between two numbers may also find it helpful to count up from 27 to 74 using an empty number line.

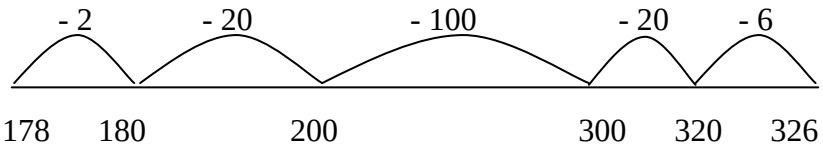
74 – 27



Stage 2

Using a number line with larger numbers and estimation.

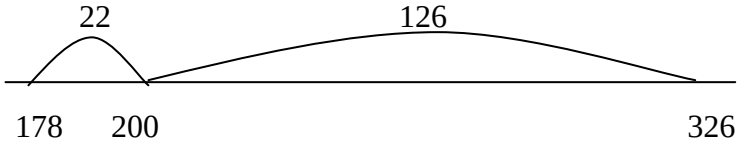
326 – 178



Stage 3

Using a number line with larger steps. Estimate first.

326 – 178



Stage 4

Compact vertical layout with no decomposition, working from the least significant digit first in readiness for decomposition. In this example the least significant digit is the units.

```
  378
- 126
  252
```

Stage 5

Introduce decomposition with expanded vertical layout. However, if some children have a secure understanding of the compact method and of place value, this stage may be omitted.

326 –178

		110		
200		~~10~~		16
~~300~~		~~20~~		~~6~~
-100		70		8
100	+	40	+	8

Stage 6

Compact method with decomposition

	2	11	1
	~~3~~	~~2~~	6
-	1	7	8
	1	4	8

Multiplication and Division

Criteria, which would indicate a child's readiness for formal written methods (e.g stage 3) of multiplication and division, include:

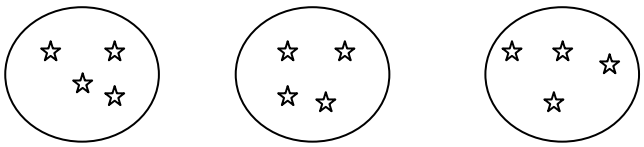
- Recall of multiplication and corresponding division facts for 2, 3, 4, 5 and 10 times tables. Knowledge of multiplication and division facts for all tables up to 12 x 12 is desirable.
- Understanding of what happens when a number is multiplied by 0 or 1.
- Understanding of place value.
- Understanding of 0 as a place holder.
- Ability to multiply two and three digit numbers mentally by 10 and 100.
- Ability to approximate products and quotients using powers of 10.
- Understanding of commutative, distributive and associative laws of multiplication (though not these terms).
- Ability to double and halve two digit numbers mentally.
- Ability to use multiplication facts to derive mentally new multiplication facts.
- Ability to explain mental strategies, orally and in writing.

Progression in Multiplication

Stage 1

Using pictorial representation or written description

3 x 4



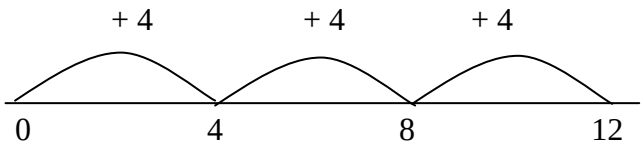
An array showing 3 x 4

☆ ☆ ☆ ☆
☆ ☆ ☆ ☆
☆ ☆ ☆ ☆

Stage 2

Using a number line, showing repeated addition.

3 x 4



Stage 3

Using partitioning, a mental method, which forms a basis for future more compact methods.

38 x 7 = (30 x 7) + (8 x 7)

= 210 + 56

= 266

Stage 4

The grid method which introduces partitioning using place value. The significant digit is multiplied first in order to get a sense of the size of the answer.

X	**30**	**8**	
7	210	56	266

Stage 5

Multiplication by a single digit, using expanded working in a vertical format. The least significant digit is recorded first. The children should be able to link this format with the grid method.

```
  38
x  7
  56 ( 7 x 8 )
 210 ( 7 x 30 )
 266
```

Stage 6

Multiplication by a single digit, using vertical format and compact working.

```
  38
x  7
266
 5
```

Stage 7

Extend grid method to larger numbers and multiplication by two digit numbers.

56 x 27

x	**50**	**6**	
20	1000	120	1120
7	350	42	392
			1512

Stage 8

Multiplication by a two digit number using an expanded vertical format. Recording the least significant digit first. Some children may be able to transfer their understanding of the grid method into compact recording (stage 9) and omit this stage.

```
  56
x 27
  42   (7 x 6)
 350   (7 x 50)
 120   (20 x 6)
1000   (20 x 50)
1512
```

Stage 9

Compact method recording the least significant digit first. The children may need to use jottings to support multiplication.

```
  56
x 27
 392   (7 x 56)
1120   (20 x 56)
1512
 1
```

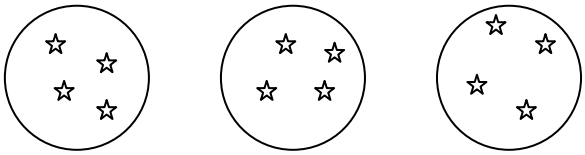
Progression in Division

Stage 1

Before introducing expanded methods division may be recorded in a number of ways to facilitate understanding.

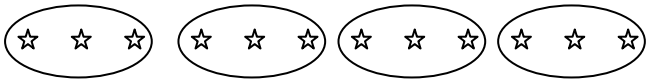
Sharing

12 ÷3



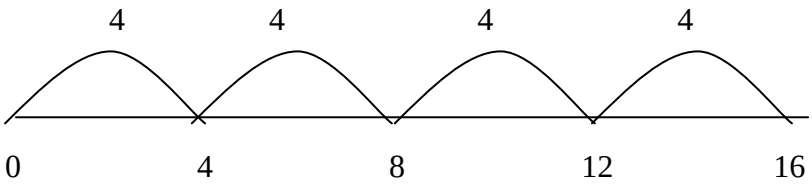
Grouping

12 ÷3



Recording on an empty number line (as repeated subtraction, starting from 16, or as counting in steps of 4 until 16 is reached)

16 ÷ 4



Stage 2

Children are shown that division can be completed by repeated subtraction.

25 ÷ 6

25
-6
19
-6
13
-6
7
-6
1

I took away 4 lots of 6 and had one left over.

Stage 3

Using known facts to arrive at an answer.

97 ÷ 9

We know 10 x 9 = 90 with a remainder of 7

97 ÷ 9 = 10 r 7

Stage 4

Introduce vertical layout and the symbol for division. ⟌

97 ÷ 9

9 ⟌ 97
90
7
Answer 10 r 7

Stage 5

Using vertical layout, introduce larger numbers with the children subtracting in larger chunks provided they are comfortable with doing so. Answers should be estimated before the calculation. This method may be inefficient when working with very large numbers and children may find it beneficial to use the compact method outlined in stage 6.

```
6 |196
  -120   (6 x 20)
    76
   -60   (6 x 10)
    16
   -12   (6 x 2)
     4

     32  r 4
```

```
6 |196
  -180   (6 x 30)
    16
   -12   (6 x 2)
     4

     32  r 4
```

Stage 6

Introduce the compact method, using zero as a place holder.

```
    32 r 4
6 |196
  -180
    16
   -12
     4
```

Stage 7

Use the same methods for larger numbers and decimals.

```
    3 · 25
6 |19 · 50
  -18      (6 x 3)
    1. 50
    1. 50 (6 x 0.25)
```