Calculation Policy

Nanpean CP School

September 2014

Within the National Curriculum (2014) there is a great emphasis placed on taught calculation methods. The following appendix references the statutory requirements of teaching calculation over the four operations and is sorted by key stage and year group.

*K1.1a-Addition and Subtraction pupils in **Year 1** must be taught to:*

- read, write and interpret mathematical statements involving addition (+), subtraction (–) and equals (=) signs
- represent and use number bonds and related subtraction facts within 20
- add and subtract one-digit and two-digit numbers to 20, including zero
- solve one-step problems that involve addition and subtraction, using concrete objects and pictorial representations, and missing number problems such as 7 = – 9.

*K1.1b-Multiplication and Division pupils in **Year 1** must be taught to:*

- solve one-step problems involving multiplication and division, by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher.

*K2.1a-Addition and Subtraction pupils in **Year 2** must be taught to:*

- solve problems with addition and subtraction:
- using concrete objects and pictorial representations, including those involving numbers, quantities and measures
- applying their increasing knowledge of mental and written methods
- recall and use addition and subtraction facts to 20 fluently, and derive and use related facts up to 100
- add and subtract numbers using concrete objects, pictorial representations, and mentally, including:
    - a two-digit number and ones
    - a two-digit number and tens
    - two two-digit numbers
    - adding three one-digit numbers
- show that addition of two numbers can be done in any order (commutative) and subtraction of one number from another cannot
- recognise and use the inverse relationship between addition and subtraction and use this to check calculations and solve missing number problems.

*K2.1b-Multiplication and Division pupils in **Year 2** must be taught to:*

- recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables, including recognising odd and even numbers
- calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (×), division (÷) and equals (=) signs
- show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot
- solve problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in contexts.

*K2.3a-Within Addition and Subtraction pupils in **Year 3** must be taught to:*

- add and subtract numbers mentally, including:
- a three-digit number and ones
- a three-digit number and tens
- a three-digit number and hundreds
- add and subtract numbers with up to three digits, using formal written methods of columnar addition and subtraction
- estimate the answer to a calculation and use inverse operations to check answers
- solve problems, including missing number problems, using number facts, place value, and more complex addition and subtraction.

*K2.3b-Within Multiplication and Division pupils in **Year 3** must be taught to:*

- recall and use multiplication and division facts for the 3, 4 and 8 multiplication tables
- write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods
- solve problems, including missing number problems, involving multiplication and division, including positive integer scaling problems and correspondence problems in which n objects are connected to m objects.

*K2.4a- Addition and Subtraction pupils in **Year 4** must be taught to:*

- add and subtract numbers with up to 4 digits using the formal written methods of columnar addition and subtraction where appropriate
- estimate and use inverse operations to check answers to a calculation
- solve addition and subtraction two-step problems in contexts, deciding which operations and methods to use and why.

*K2.4b-Within Multiplication and Division pupils in **Year 4** must be taught to:*

- recall multiplication and division facts for multiplication tables up to 12 × 12
- use place value, known and derived facts to multiply and divide mentally, including: multiplying by 0 and 1; dividing by 1; multiplying together three numbers
- recognise and use factor pairs and commutativity in mental calculations
- multiply two-digit and three-digit numbers by a one-digit number using formal written layout
- solve problems involving multiplying and adding, including using the distributive law to multiply two digit numbers by one digit, integer scaling problems and harder correspondence problems such as n objects are connected to m objects.

*K2.5a-Addition and Subtraction pupils in **Year 5** must be taught to:*

- add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction)
- add and subtract numbers mentally with increasingly large numbers
- use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy
- solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why.

*K2.5b-Within Multiplication and Division pupils in **Year 5** must be taught to:*

- identify multiples and factors, including finding all factor pairs of a number, and common factors of two numbers
- know and use the vocabulary of prime numbers, prime factors and composite (non-prime) numbers
- establish whether a number up to 100 is prime and recall prime numbers up to 19
- multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers
- multiply and divide numbers mentally drawing upon known facts
- divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context
- multiply and divide whole numbers and those involving decimals by 10, 100 and 1000

*K2.6a-Addition and Subtraction, and Multiplication and Division-pupils in **Year 6** must be taught to:*

- multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication
- divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context
- divide numbers up to 4 digits by a two-digit number using the formal written method of short division where appropriate, interpreting remainders according to the context
- perform mental calculations, including with mixed operations and large numbers
- identify common factors, common multiples and prime numbers
- use their knowledge of the order of operations to carry out calculations involving the four operations
- solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why

*K2.6b-Within Fraction, Addition, Subtraction, Multiplication and Division are also referred to and pupils in **Year 6** must be taught to:*

- add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions
- multiply simple pairs of proper fractions, writing the answer in its simplest form [for example, 41 × 21 = 81]
- divide proper fractions by whole numbers [for example, 31 ÷ 2 = 61]
- associate a fraction with division and calculate decimal fraction equivalents [for example, 0.375] for a simple fraction [for example, 83]
- identify the value of each digit in numbers given to three decimal places and multiply and divide numbers by 10, 100 and 1000 giving answers up to three decimal places
- multiply one-digit numbers with up to two decimal places by whole numbers
- use written division methods in cases where the answer has up to two decimal places

Addition

Written methods for addition of whole numbers
The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use an efficient written method accurately and with confidence. These notes show the stages in building up to using an efficient written method for addition of 3 digit numbers by the end of Year 3.

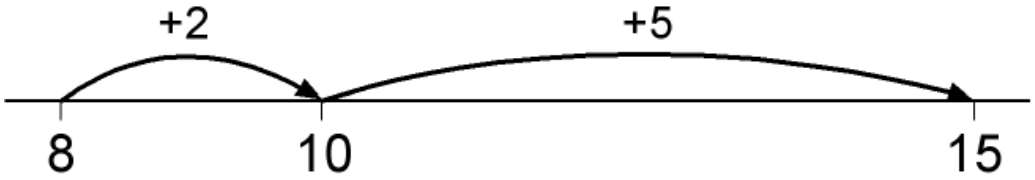
Note: *It is important that children's mental methods of calculation are practised on a regular basis and secured alongside their learning and use of an efficient written method for addition.*

Using and Applying
Before children move onto the next stage in written calculation it is important that their skills are broadened through their use and application in a range of contexts (including money, time and other measures).

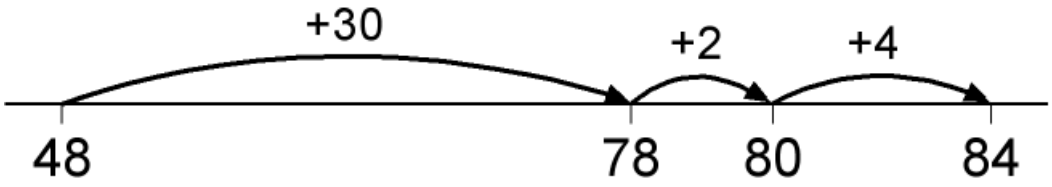
Stage 1: The empty number line

Steps in addition can be recorded on a number line. The steps often bridge through a multiple of 10.

$8 + 7 = 15$



48 + 36 = 84



or:



Stage 2: Partitioning

Record steps in addition using partitioning:

76 + 47 = 76 + 40 + 7 = 116 + 7 = 123

76 + 47 = 70 + 40 + 6 + 7 = 110 + 13 = 123

47= 40 + 7

+<u>76</u>= <u>70 + 6</u>

110+13 = 123 or in a grid

40	7
70	6
110	13

Stage 3: Expanded method in columns

Write the numbers in columns.

Adding the tens first to follow on from Partitioning:

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

Moving on to adding the ones first:

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

Discuss how adding the ones first gives the same answer as adding the tens first. Refine over time to adding the ones digits first consistently.

Stage 4: Column method (efficient)

Ask children to estimate first.

```
 47
+76
123
 11
```

```
 258
+ 87
 345
 11
```

```
 258
+458
 826
 11
```

Children need to have experience of adding more than two numbers.

Column addition remains efficient when used with larger whole numbers and decimals. Once learned, the method is quick and reliable.

Subtraction

Written methods for subtraction of whole numbers

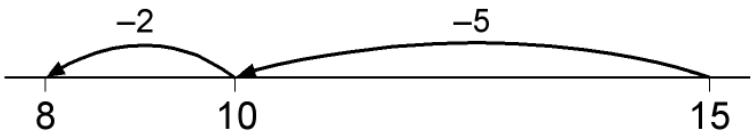
The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use an efficient written method accurately and with confidence. Children are entitled to be taught and to acquire secure mental methods of calculation and one efficient written method of calculation for subtraction which they know they can rely on when mental methods are not appropriate.
These notes show the stages in building up to using an efficient method for subtraction of two-digit and three-digit whole numbers by the end of Year 3.

Note: *It is important that children's mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for subtraction.*

Using and Applying
Before children move onto the next stage in written calculation it is important that their skills are broadened through their use and application in a range of contexts (including money, time and other measures).

SUBTRACTION *Following on from number line / track*

(To be introduced before counting-up) Steps in subtraction can be recorded on a number line. The steps often bridge through a multiple of 10.
15 – 7 = 8



Building on from mental strategies of:

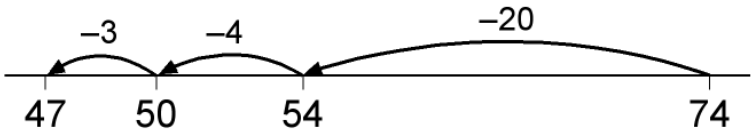
Counting back to

and

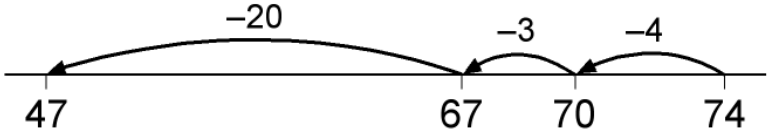
Counting back from

Either order is acceptable

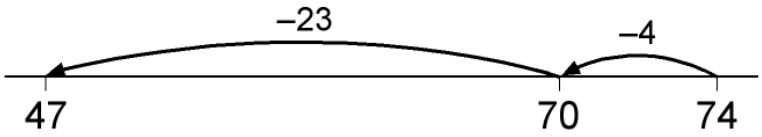
74 – 27 = 47 worked by counting back:



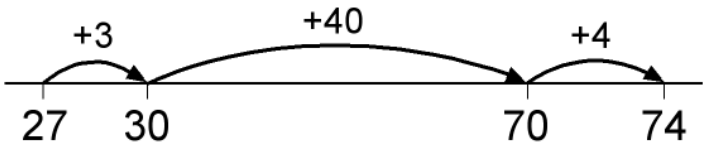
The steps may be recorded in a different order:



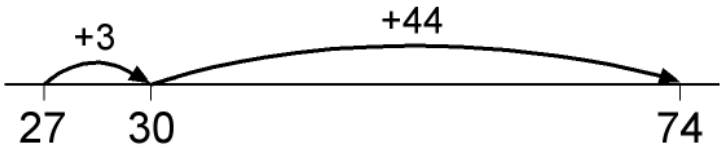
or combined:



Stage one: The counting-up method



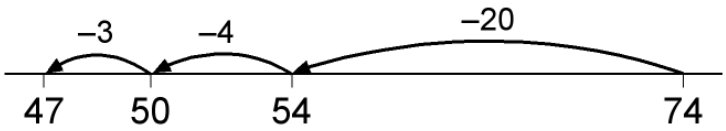
or:



With practice, children will need to record less information and decide whether to count back or forward. It is useful to ask children whether counting up or back is the more efficient for calculations such as 57 – 12, 86 – 77 or 43 – 28.

Stage 2: Partitioning

Using the 'Jump' strategy. Retain the first number and partition the second 74 – 27 = 74 – 20 – 7 = 54 – 7 = 47
This requires children to subtract a single-digit number or a multiple of 10 from a two-digit number mentally. The method of recording links to counting back on the number line.



Stage 3: Expanded layout, leading to column method

Partitioned numbers are then written under one another:
563 – 241

Leads to

-

500	60	3
200	40	1
300	20	2

322

Leads to → 563
-241
322

Example: 74 − 27

70	4
20	7

—

—

60 ~~70~~	14
20	7
40	7

Leads to

6 1
~~7~~4
- 27
47

Stage 4: column method (efficient)

Ask children to estimate first.

5 1
5~~6~~3
-248
315

Multiplication

Written methods for multiplication of whole numbers

The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use an efficient written method accurately and with confidence. Children are entitled to be taught and to acquire secure mental methods of calculation and efficient written methods of calculation for multiplication which they know they can rely on when mental methods are not appropriate.

These notes show the stages in building up to using an efficient formal written method for multiplication. Starting in Year 3 with two digit by one digit multiplication and leading totwo-digit and three-digit numbers by a one-digit number by the end of Year 4, multiply numbers up to 4 digits by a one- or two-digit number using a formal written method by the end of Year 5 and in Year 6 multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication

Note: *It is important that children's mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for multiplication.*

Using and Applying

Before children move onto the next stage in written calculation it is important that their skills are broadened through their use and application in a range of contexts (including money, time and other measures).

Stage 1: Mental multiplication using partitioning (towards informal)

Year 3, for example when they use their knowledge of the 2, 5 and 10 times tables to work out multiples of 7:



This would be done through questioning during practical activities with counting equipment *"You have shown me 5 lots of 3. If I needed to know what 7 lots of 3 is, what could I do?"*

7x3= (5+2) x3= (5x3) + (2x3) = 15+6=21

Stage 2: The grid method (partitioning)

7x37 =

x	30	7
7	210	49
		259

27x56=

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

Stage 3: Efficient multiplication

Ask children to estimate first.

38 x 7 is approximately
40 x 7 = 280

56 × 27 is approximately
60 × 30 = 1800

```
  38
x  7
266
 5
```

```
  56
 x27
1120
 392
1512
 1
```

Division

Written methods for division of whole numbers

The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use an efficient written method accurately and with confidence. Children are entitled to be taught and to acquire secure mental methods of calculation and one efficient written method of calculation for division which they know they can rely on when mental methods are not appropriate.

These notes show the stages in building up to long division through Years 4 to 6 – first long division TU ÷ U, extending to HTU ÷ U, then HTU ÷ TU, and then short division HTU ÷ U.

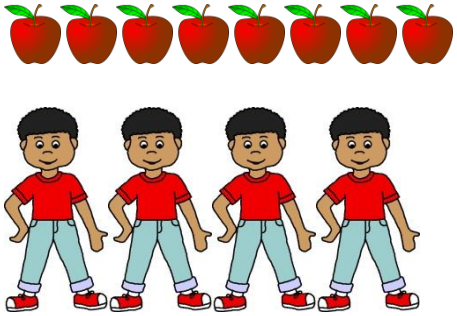
To divide successfully in their heads, children need to be able to:

Note: *It is important that children's mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for division.*

Using and Applying -Before children move onto the next stage in written calculation it is important that their skills are broadened through their use and application in a range of contexts (including money, time and other measures).

Stage 1: Sharing

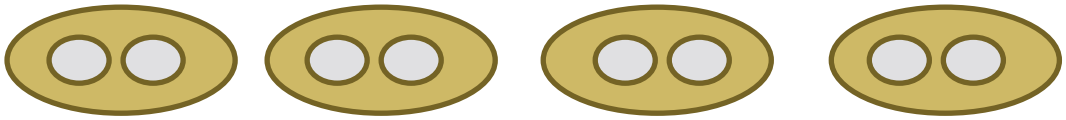
Children work practically in one to one sharing activities. They understand that they are sharing equally so that each group has the same amount



Sharing 8 between 4

Stage 2: Grouping

Children work practically in grouping activities, moving onto representing this using a number line



How many 2s are there in 12?



Stage 3: 'Expanded' method through chunking

97 ÷ 9

9 97
-90 9x10
7

Answer: 10 R7

196÷6

6 196

-60 6x10
136
-60 6x10
76
-60 6x10
16
-12 6x2
4 32

Answer: 32 r 4

Stage 4: Long division

$$
\begin{array}{rl}
24\overline{)560} & \\
\underline{480} & 24\text{x } 20 \\
80 & \\
\underline{72} & 24 \text{ x } 3 \\
8 &
\end{array}
$$

Stage 5: Short division

The short division method is recorded like this:

$$
\begin{array}{r}
2_{2}7 \\
3\overline{)81}
\end{array}
$$

The carry digit ‘2’ represents the 2 tens that have been exchanged for 20 ones. The concept being how many 3’s fit into 8? 2 with 2 left over, then how many 3’s fit into 21? 7