Written Calculations Policy

NAME OF SCHOOL: Worple Primary School

DATE OF IMPLEMENTATION: June 2013

MEMBER OF STAFF RESPONSIBLE: MATHS CO-ORDINATOR

REVIEW DATE: June 2015

RATIONALE

The National Numeracy Strategy provides a structured and systematic approach to the teaching of calculation. There is considerable emphasis on teaching mental calculation methods.

Up to the age of 9 (end of Year 4) informal written recording is practised regularly and is an important part of learning and understanding.

More formal written methods follow when a child is able to use a wide range of mental strategies (sometimes before the end of Year 4 if chn/a child are secure with informal methods).

Worple Primary School has developed a consistent approach to the teaching of written calculations in order to establish continuity and progression through out the school.

AIMS & OBJECTIVES

Children should be able to choose an efficient method; mental, written or calculator appropriate, to the given task.

By the end of Year 6, children working at Level 4 and above will have been taught, and be secure with, a compact standard method for each operation.

General Progression

- Establish mental methods based on a good understanding of place value
- Use of informal jottings to aid metal calculations
- Develop use of an empty number line to help mental imagery and aid recording
- Use of partitioning and recombining to aid informal methods

• Introduce expanded written methods
• Develop expanded written methods into compact standard written form.

Before carrying out a calculation, children should be encouraged to consider:
• Can I do it in my head? (Using rounding, adjustment)
• The size of an approximate answer (estimation)
• Could I do jottings to keep track of the calculation?
• Do I need to use an expanded or compact written method?
(Children may not refer to these names but will understand the methods)

When are children ready for written calculations?
Addition and subtraction
• Do they know addition and subtraction facts to 20?
• Do they understand place value and can they partition numbers?
• Can they add three single digit numbers mentally?
• Can they add and subtract any pair of two digit numbers mentally?
• Can they explain their mental strategies orally and record them using informal jottings?
Multiplication and division
• Do they know the 2,3,4,5 and 10 times tables?
• Do they know the result of multiplying by 1 and 0?
• Do they understand 0 as a place holder?
• Can they multiply two and three digit numbers by 10 and 100?
• Can they double and halve two digit numbers mentally?
• Can they use multiplication facts they know to derive mentally other multiplication facts that they do not know?
• Can they explain their mental strategies orally and record them using informal jottings?

Vocabulary
The correct terminology should be used when referring to the value of digits to support children's understanding of place value.
E.g. 68 + 47 should be read 'sixty add forty' not 'six add four'.

PROGRESSION THROUGH CALCULATIONS FOR ADDITION

MENTAL CALCULATIONS

(ongoing)
These are a **selection** of mental calculation strategies:
See NNS Framework Section 5, pages 30-41 and Section 6, pages 40-47

Mental recall of number bonds

6 + 4 = 10	□ + 3 = 10
25 + 75 = 100	19 + □ = 20

Use near doubles

6 + 7 = double 6 + 1 = 13

Addition using partitioning and recombining

34 + 45 = (30 + 40) + (4 + 5) = 79

Counting on or back in repeated steps of 1, 10, 100, 1000

86 + 57 = 143 (by counting on in tens and then in ones)
460 - 300 = 160 (by counting back in hundreds)

Add the nearest multiple of 10, 100 and 1000 and adjust

24 + 19 = 24 + 20 – 1 = 43
458 + 71 = 458 + 70 + 1 = 529

Use the relationship between addition and subtraction

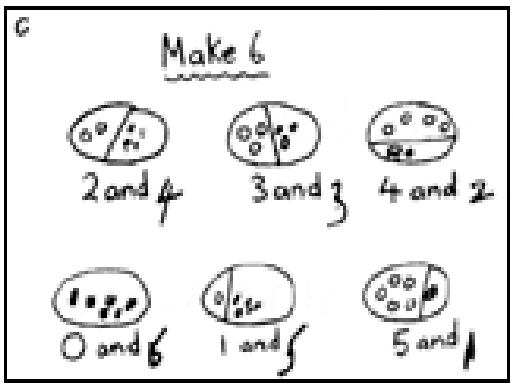
36 + 19 = 55	19 + 36 = 55
55 – 19 = 36	55 – 36 = 19

MANY MENTAL CALCULATION STRATEGIES WILL CONTINUE TO BE USED. THEY ARE NOT REPLACED BY WRITTEN METHODS.

ADDITION WRITTEN CALCULATIONS

YR and Y1

Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures, etc.

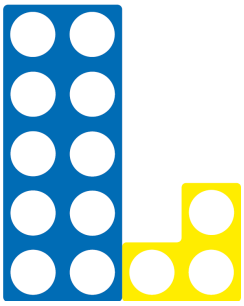


They use practical resources to support calculation and teachers *demonstrate* the use of the number line.

Children are introduced to the + sign and write their additions like this:
3 + 2 = 5

Children move on to adding 3 small numbers.

Numicon and or cubes can be used to illustrate addition

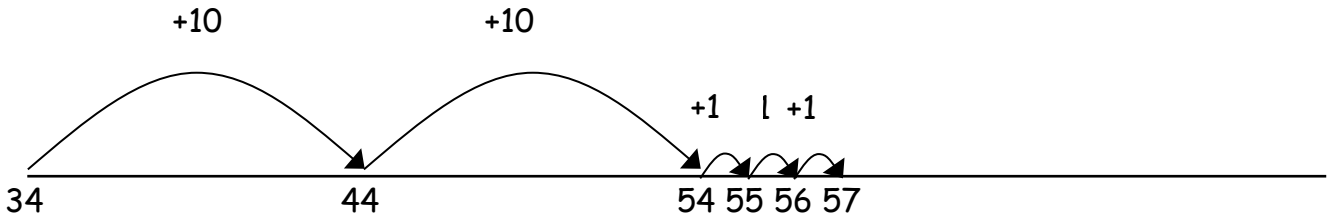


Y2

Children will begin to use 'empty number lines' themselves starting with the larger number and counting on.

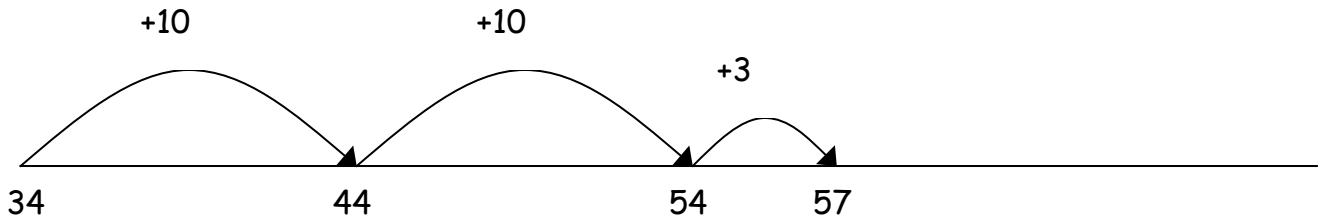
✓ First counting on in tens and ones.

34 + 23 = 57



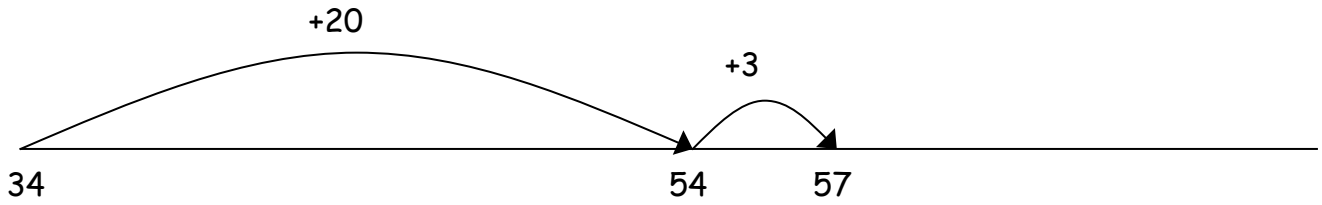
✓ Then helping children to become more efficient by adding the units in one jump (by using the known fact 4 + 3 = 7).

34 + 23 = 57



✓ Followed by adding the tens in one jump and the units in one jump.

34 + 23 = 57



More able children will move onto partitioning, splitting the tens and units.

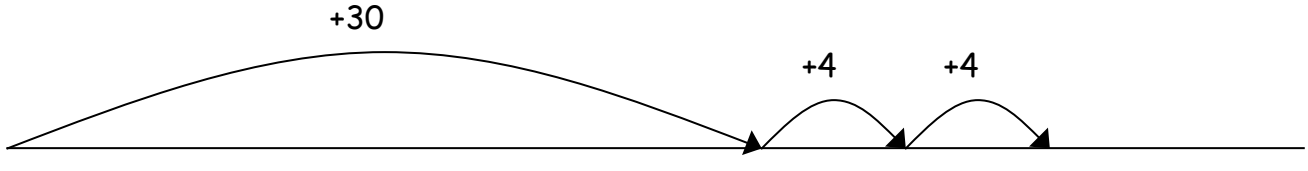
37 + 15 = (30 + 10) + (7 + 5)
= 40 + 12
= 52

Y3

Children will continue to use empty number lines with increasingly large numbers.

✓ Count on from the largest number irrespective of the order of the calculation.

38 + 86 = 124



86 116 120 124

Children will begin to use informal pencil and paper methods (jottings) to support record and explain partial mental methods building on existing mental strategies.

- ✓ Children will use the partitioning method
  37 + 15 = (30 + 10) + (7 + 5)
  = 40 + 12
  = 52

Y4

From this, children will begin to carry below the line.

625	783	367
+ 48	+ 42	+ 85
673	825	452
1	1	1 1

Using similar methods, children will:

- ✓ *add several numbers with different numbers of digits;*
- ✓ *begin to add two or more three-digit sums of money, with or without adjustment from the pence to the pounds;*
- ✓ *know that the decimal points should line up under each other, particularly when adding or subtracting mixed amounts, e.g. £3.59 + 78p.*

Y5

Children should extend the carrying method to numbers with at least four digits.

587	3587
+ 475	+ 675
1062	4262
1 1	1 1 1

Using similar methods, children will:

- ✓ *add several numbers with different numbers of digits;*
- ✓ *begin to add two or more decimal fractions with up to three digits and the same number of decimal places;*
- ✓ *know that decimal points should line up under each other, particularly when adding or subtracting mixed amounts, e.g. 3.2 m – 280 cm.*

Y6

Children should extend the carrying method to number with any number of digits.

7648	6584	42
+ 1486	+ 5848	6432
9134	12432	786
1 1 1	1 1 1	3
		+ 4681
		11944
		1 2 1

Using similar methods, children will

- ✓ *add several numbers with different numbers of digits;*
- ✓ *begin to add two or more decimal fractions with up to four digits and either one or two decimal places;*
- ✓ *know that decimal points should line up under each other, particularly when adding or subtracting mixed amounts, e.g. 401.2 + 26.85 + 0.71.*

+ - + - + - + - + - + - +

By the end of year 6, children will have a range of calculation methods, mental and written. Selection will depend upon the numbers involved.

Children should not be made to go onto the next stage if:

1) **they are not ready.**
2) **they are not confident.**

Children should be encouraged to approximate their answers before calculating. Children should be encouraged to check their answers after calculation using an appropriate strategy. Children should be encouraged to consider if a mental calculation would be appropriate before using written methods.

PROGRESSION THROUGH CALCULATIONS FOR SUBTRACTION

MENTAL CALCULATIONS

(ongoing)

These are a **selection** of mental calculation strategies:

See NNS Framework Section 5, pages 30-41 and Section 6, pages 40-47

Mental recall of addition and subtraction facts

10 – 6 = 4 17 - □ = 11

20 - 17 = 3 10 - □ = 2

Find a small difference by counting up
82 – 79 = 3

Counting on in repeated steps of 1, 10, 100, 1000
86 - 52 = 34 (by counting back in tens and then in ones)
460 - 300 = 160 (by counting back in hundreds)

Subtract the nearest multiple of 10, 100 and 1000 and adjust
24 - 19 = 24 - 20 + 1 = 5
458 - 71 = 458 - 70 - 1 = 387

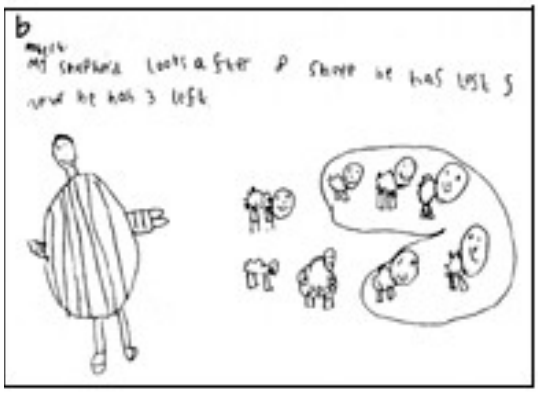
Use the relationship between addition and subtraction
36 + 19 = 55 19 + 36 = 55
55 – 19 = 36 55 – 36 = 19

MANY MENTAL CALCULATION STRATEGIES WILL CONTINUE TO BE USED. THEY ARE NOT REPLACED BY WRITTEN METHODS.

Subtraction Written Calculations

YR and Y1

Children use practical resources to support calculation.
Children are then encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures etc.



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Number lines, Numicon and cubes can be used to illustrate subtraction including bridging through ten by counting back 3 then counting back 2.

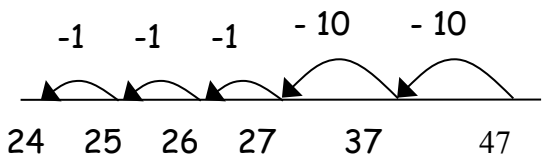
Y2

Children will begin to use empty number lines to support calculations.

Counting back

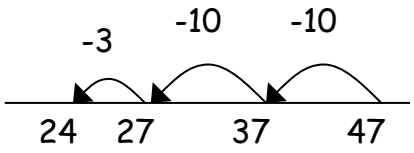
✓ First counting back in tens and ones.

47 – 23 = 24



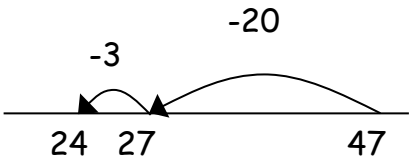
- ✓ Then helping children to become more efficient by subtracting the units in one jump (by using the known fact 7 – 3 = 4).

47 – 23 = 24



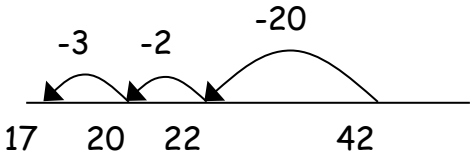
- ✓ Subtracting the tens in one jump and the units in one jump.

47 – 23 = 24



- ✓ Bridging through ten can help children become more efficient.

42 – 25 = 17



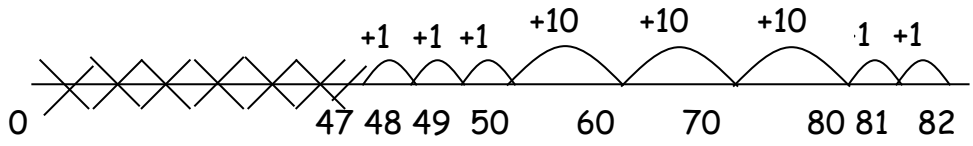
Counting on

If the numbers involved in the calculation are close together or near to multiples of 10, 100 etc, it can be more efficient to count on.

Count up from 47 to 82 in jumps of 10 and jumps of 1.

The number line should still show 0 so children can cross out the section from 0 to the smallest number. They then associate this method with 'taking away'.

82 - 47



Help children to become more efficient with counting on by:

- ✓ Subtracting the units in one jump;
- ✓ Subtracting the tens in one jump and the units in one jump;
- ✓ Bridging through ten.

Y3

Children will continue to use empty number lines with increasingly large numbers.

Children will begin to use informal pencil and paper methods (jottings) to support record and explain partial mental methods building on existing mental strategies.

Partitioning and decomposition

```
  89   =   80  +  9                    89 – 50 = 59
- 57       50  +  7        or          39-7 = 32
             30  +  2  = 32
```

Initially, the children will be taught using examples that do not need the children to exchange.

From this the children will begin to exchange.

```
  71   =         =
- 46
```

```
Step 1     70  +  1
         - 40  +  6

Step 2     60  +  11
         - 40  +  6
           20  +  5  =  25
```

The calculation should be read as e.g. take 6 from 1.

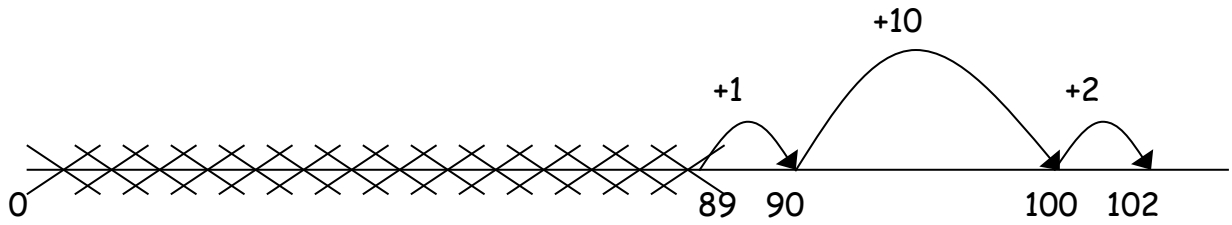
This would be recorded by the children as

```
    60
   7⁄0  +  ¹1
- 40  +  6
  20  +  5  = 25
```

Children should know that units line up under units, tens under tens, and so on.

Where the numbers are involved in the calculation is close together or near to multiples of 10, 100 etc counting on using a number line should be used.

102 – 89 = 13



Y4

Decomposition

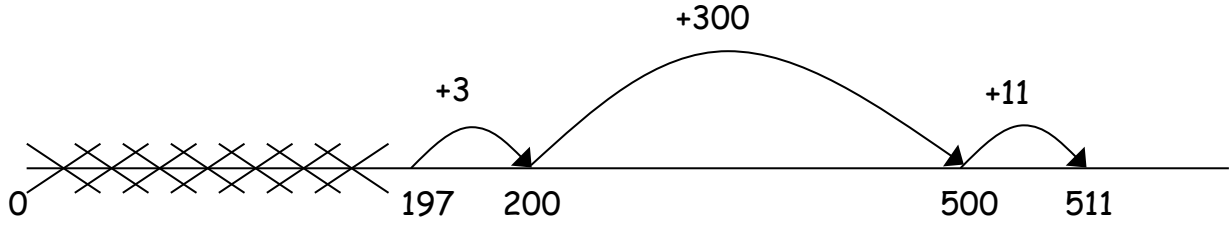
$$\begin{array}{r} {}^{6}\not{7}{}^{14}\not{5}\,{}^{1}\not{4} \\ -\ 86 \\ \hline 668 \end{array}$$

Children should:

- ✓ *be able to subtract numbers with different numbers of digits;*
- ✓ *using this method, children should also begin to find the difference between two three-digit sums of money, with or without 'adjustment' from the pence to the pounds;*
- ✓ *know that decimal points should line up under each other.*

Where the numbers are involved in the calculation are close together or near to multiples of 10, 100 etc counting on using a number line should be used.

511 – 197 = 314



Y5

- ✓ Children will move onto compact decomposisition when appropriate.

Decomposition

$$\begin{array}{r} {}^{6}\not{7}{}^{14}\not{5}\,{}^{1}\not{4} \\ -\ 286 \\ \hline 468 \end{array}$$

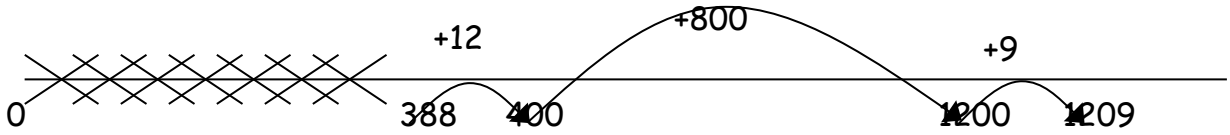
Children should:

- ✓ *be able to subtract numbers with different numbers of digits;*
- ✓ *begin to find the difference between two decimal fractions with up to three digits and the same number of decimal places;*
- ✓ *know that decimal points should line up under each other.*

NB If your children have reached the concise stage they will then continue this method through into year 6. They will not go back to using the expanded methods.

Where the numbers are involved in the calculation are close together or near to multiples of 10, 100 etc counting on using a number line should be used.

1209 – 388 = 821



Y6

Decomposition

$$\begin{array}{r} {}^{5}\not{6}{}^{13}\not{4}\,{}^{1}\not{7} \\ -\ 2684 \\ \hline 3783 \end{array}$$

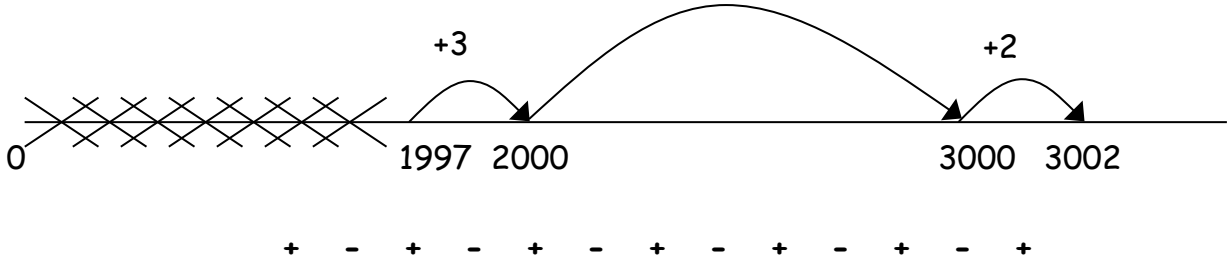
Children should:

- ✓ *be able to subtract numbers with different numbers of digits;*
- ✓ *be able to subtract two or more decimal fractions with up to three digits and either one or two decimal places;*
- ✓ *know that decimal points should line up under each other.*

Where the numbers are involved in the calculation are close together or near to multiples of 10, 100 etc counting on using a number line should be used.

3002 – 1997 = 1005

+1000



By the end of year 6, children will have a range of calculation methods, mental and written. Selection will depend upon the numbers involved.

Children should not be made to go onto the next stage if:

3) **they are not ready.**
4) **they are not confident.**

Children should be encouraged to approximate their answers before calculating.
Children should be encouraged to check their answers after calculation using an appropriate strategy.
Children should be encouraged to consider if a mental calculation would be appropriate before using written methods.

PROGRESSION THROUGH CALCULATIONS FOR MULTIPLICATION

MENTAL CALCULATIONS
(ongoing)
These are a **selection** of mental calculation strategies:
See NNS Framework Section 5, pages 52-57 and Section 6, pages 58-65

Doubling and halving
Applying the knowledge of doubles and halves to known facts.
e.g. 8 x 4 is double 4 x 4

Using multiplication facts

Tables should be taught everyday from Y2 onwards, either as part of the mental oral starter or other times as appropriate within the day.

Year 2
- 2 times table
- 5 times table
- 10 times table

Year 3
- 2 times table
- 3 times table
- 4 times table
- 5 times table
- 6 times table
- 10 times table

Year 4 Derive and recall all multiplication facts up to 10 x 10

Years 5 & 6 Derive and recall quickly all multiplication facts up to 10 x 10.

Using and applying division facts
Children should be able to utilise their tables knowledge to derive other facts.
e.g. If I know 3 x 7 = 21, what else do I know?
30 x 7 = 210, 300 x 7 = 2100, 3000 x 7 = 21 000, 0.3 x 7 = 2.1 etc

Use closely related facts already known
13 x 11 = (13 x 10) + (13 x 1)
= 130 + 13
= 143

Multiplying by 10 or 100
Knowing that the effect of multiplying by 10 is a shift in the digits one place to the left.

Knowing that the effect of multiplying by 100 is a shift in the digits two places to the left.

Partitioning

23 x 4 = (20 x 4) + (3 x 4)
= 80 + 12
= 102

Use of factors

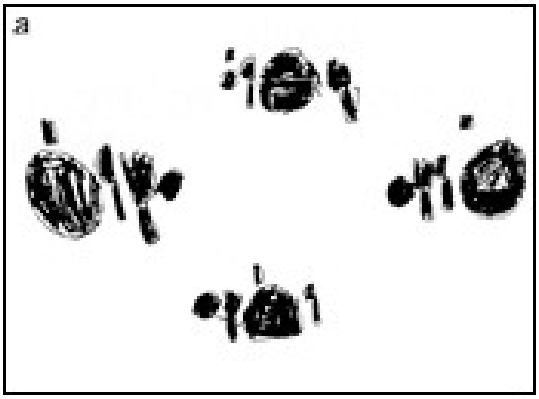
8 x 12 = 8 x 4 x 3

MANY MENTAL CALCULATION STRATEGIES WILL CONTINUE TO BE USED. THEY ARE NOT REPLACED BY WRITTEN METHODS.

Multiplication Written Calculations

YR and Y1

Children will experience equal groups of objects and will count in 2s and 10s and begin to count in 5s. They will work on practical problem solving activities involving equal sets or groups. (Using Numicon or stacking cubes)



Y2

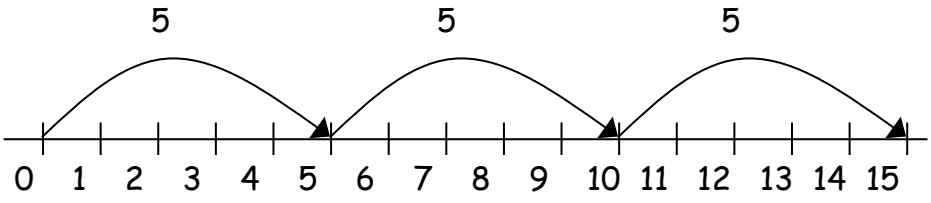
Children will develop their understanding of multiplication and use jottings to support calculation:

- ✓ **Repeated addition**

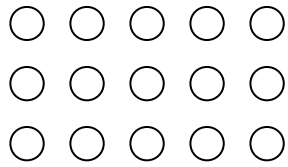
3 times 5 is 5 + 5 + 5 = 15 or 3 lots of 5 or 5 x 3

Repeated addition can be shown easily on a number line:

5 x 3 = 5 + 5 + 5



Arrays



5 x 3 = 15

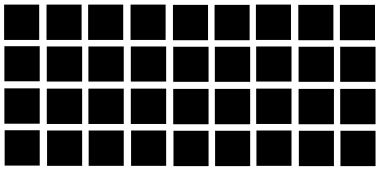
3 x 5 = 15

Y3

Children will continue to use:

- ✓ **Repeated addition**
- ✓ **Arrays**

Using Numicon:



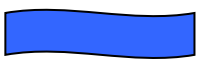
9 x 4 = 36

9 x 4 = 36

Children will also develop an understanding of

- ✓ **Scaling**

e.g. Find a ribbon that is 4 times as long as the blue ribbon



5 cm

20 cm

- ✓ **Partitioning**

38 x 5 = (30 x 5) + (8 x 5)
= 150 + 40
= 190

NNS Section 5 page 47

Y4

Some children will continue to use the year 3 methods where appropriate.
Children will continue to use arrays where appropriate leading into the grid method of multiplication.

Grid method

TU x U
(Short multiplication – multiplication by a single digit)

23 x 8

Children will approximate first
23 x 8 is approximately 25 x 8 = 200

x	20	3
8	160	24

160
+ 24
184

- ✓ Partitioning will continue to be used with all children (as year 3)
- ✓ More able children will then use partitioning to lead to a short multiplication method.

23
x 8
24 (3x8)
160 (20x8)
184

Y5

Column Method

HTU x U
(Short multiplication – multiplication by a single digit)

38x7

Children will approximate first

$$\begin{array}{r} 38 \\ \times\ 7 \\ \hline 210 \\ 56 \\ \hline 266 \\ \hline \end{array}$$

1 1

TU x TU
(Long multiplication – multiplication by more than a single digit)

72 x 38

Children will approximate first
72 x 38 is approximately 70 x 40 = 2800

x	70	2
30	2100	60
8	560	16

$$\begin{array}{r} 2100 \\ +\ 560 \\ +\ 60 \\ +\ 16 \\ \hline 2736 \\ \hline \end{array}$$

1

Using similar methods, they will be able to multiply decimals with one decimal place by a single digit number, approximating first. They should know that the decimal points line up under each other.

e.g. 4.9 x 3

Children will approximate first
4.9 x 3 is approximately 5 x 3 = 15

x	4	0.9
3	12	2.7

12
+ 2.7
14.7

✓ Most children will then use partitioning to lead to a short multiplication method. (TU x U and HTU x U)

23
x 8
24 (3x8)
160 (20x8)
184

leading to

23
x 8
184
2

Y6

- ✓ Children continue to use the grid method as in year 5
- ✓ Most children move onto the short multiplication method (TUxU, HTUxU
- ✓ and ThHTU xU
- ✓ More able children will move onto long multiplication (TU x TU and HTU x
- ✓ TU)

72
x38
576
2160
2736
1

✓ When ready, children will use short multiplication for calculations such as 2435 x 6 and 23.14 x 5. (Mostly in the context of money problems)

+ - + - + - + - + - + - +

By the end of year 6, children will have a range of calculation methods, mental and written. Selection will depend upon the numbers involved.

Children should not be made to go onto the next stage if:

5) **they are not ready.**
6) **they are not confident.**

Children should be encouraged to approximate their answers before calculating.

Children should be encouraged to consider if a mental calculation would be appropriate before using written methods.

PROGRESSION THROUGH CALCULATIONS FOR DIVISION

MENTAL CALCULATIONS
(ongoing)
These are a **selection** of mental calculation strategies:
See NNS Framework Section 5, pages 52-57 and Section 6, pages 58-65

Doubling and halving
Knowing that halving is dividing by 2

Deriving and recalling division facts

Tables should be taught everyday from Y2 onwards, either as part of the mental oral starter or other times as appropriate within the day.

Year 2	2 times table
	5 times table
	10 times table
Year 3	2 times table
	3 times table
	4 times table
	5 times table
	6 times table
	10 times table
Year 4	Derive and recall division facts for all tables up to 10 x 10
Year 5 & 6	Derive and recall quickly division facts for all tables up to 10 x 10

Using and applying division facts
Children should be able to utilise their tables knowledge to derive other facts.
e.g. If I know 3 x 7 = 21, what else do I know?
30 x 7 = 210, 300 x 7 = 2100, 3000 x 7 = 21 000, 0.3 x 7 = 2.1 etc

Dividing by 10 or 100
Knowing that the effect of dividing by 10 is a shift in the digits one place to the right.
Knowing that the effect of dividing by 100 is a shift in the digits two places to the right.

Use of factors

378 ÷ 21	378 ÷ 3 = 126	378 ÷ 21 = 18
	126 ÷ 7 = 18	

Use related facts

Given that 1.4 x 1.1 = 1.54

What is 1.54 ÷ 1.4, or 1.54 ÷ 1.1?

MANY MENTAL CALCULATION STRATEGIES WILL CONTINUE TO BE USED. THEY ARE NOT REPLACED BY WRITTEN METHODS.

DIVISION WRITTEN CALCULATIONS

YR and Y1

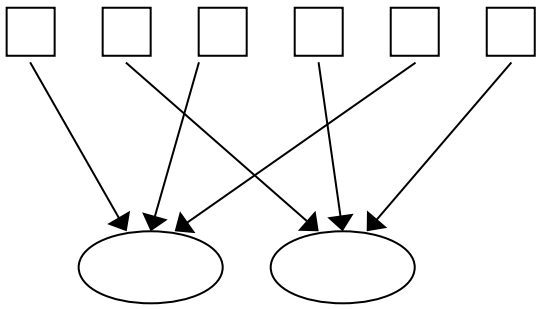
Children will understand equal groups and share items out in play and problem solving. They will count in 2s and 10s and later in 5s.

Y2

Children will develop their understanding of division and use jottings to support calculation

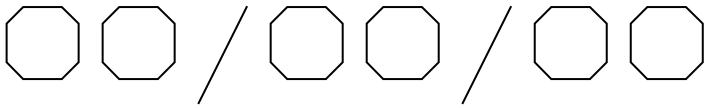
- ✓ **Sharing equally**

6 sweets shared between 2 people, how many do they each get?



- ✓ **Grouping or repeated subtraction**

There are 6 sweets, how many people can have 2 sweets each?

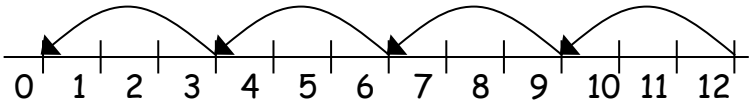


Y3

- ✓ **Children continue to work on grouping and sharing.**
- ✓ **Children will move onto using a number line for repeated subtraction.**

✓ **Repeated subtraction using a number line or bead bar**

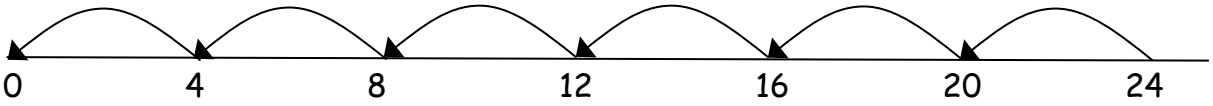
12 ÷ 3 = 4



3 3

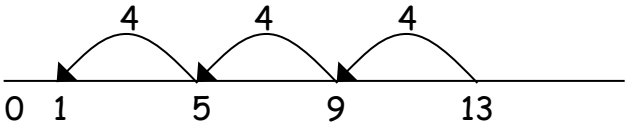
Children will use an empty number line to support their calculation.

24 ÷ 4 = 6



Children should also move onto calculations involving remainders.

13 ÷ 4 = 3 r 1



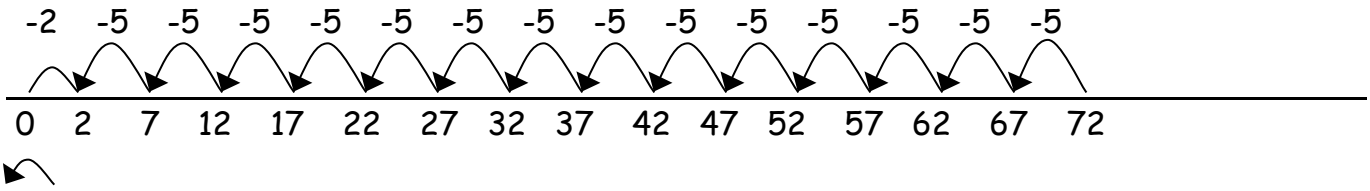
✓ **Using symbols to stand for unknown numbers to complete equations using inverse operations**

26 ÷ 2 = □ 24 ÷ △ = 12 □ ÷ 10 = 8

Y4

Children will develop their use of repeated subtraction to be able to subtract multiples of the divisor. Initially, these should be multiples of 10s, 5s, 2s and 1s – numbers with which the children are more familiar.

72 ÷ 5



Then onto the vertical method:

Children need to be able to decide what to do after division and round up or down accordingly. They should make sensible decisions about rounding up or down after division. For example 62 ÷ 8 is 7 remainder 6, but whether the answer should be rounded up to 8 or rounded down to 7 depends on the context.

e.g. I have 62p. Sweets are 8p each. How many can I buy?
Answer: 7 (the remaining 6p is not enough to buy another sweet)

Apples are packed into boxes of 8. There are 62 apples. How many boxes are needed?
Answer: 8 (the remaining 6 apples still need to be placed into a box)

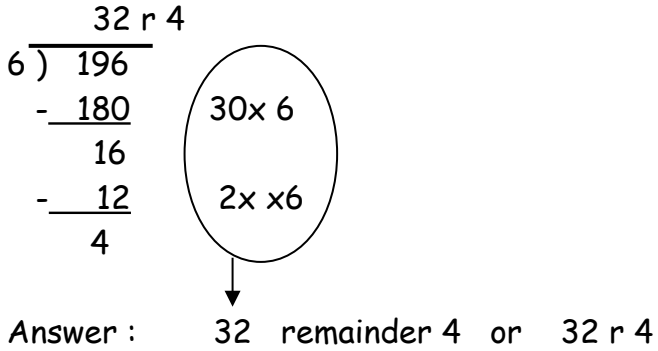
Y5

Children will continue to use written methods to solve short division TU ÷ U.

Children can start to subtract larger multiples of the divisor, e.g. 30x

Short division HTU ÷ U

196 ÷ 6



Any remainders should be shown as integers, i.e. 14 remainder 2 or 14 r 2.

Children need to be able to decide what to do after division and round up or down accordingly. They should make sensible decisions about rounding up or down after division.

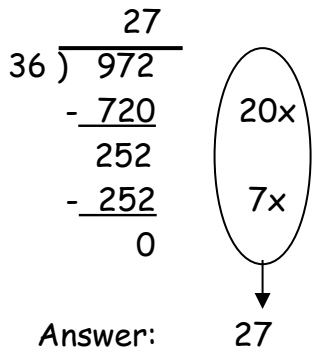
For example 240 ÷ 52 is 4 remainder 32, but whether the answer should be rounded up to 5 or rounded down to 4 depends on the context.

Y6

Children will continue to use written methods to solve short division TU ÷ U and HTU ÷ U.

Long division HTU ÷ TU

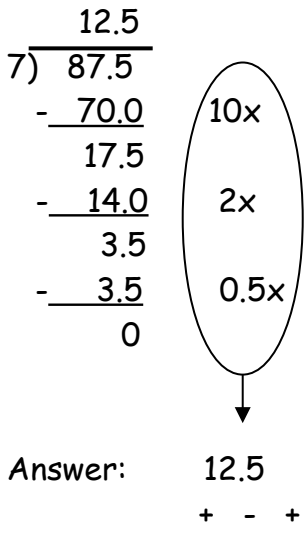
972 ÷ 36



Any remainders should be shown as fractions, i.e. if the children were dividing 32 by 10; the answer should be shown as $3\ ^{2}/_{10}$ which could then be written as $3\ ^{1}/_{5}$ in its lowest terms.

Extend to decimals with up to two decimal places. Children should know that decimal points line up under each other.

87.5 ÷ 7



By the end of year 6, children will have a range of calculation methods, mental and written. Selection will depend upon the numbers involved.

Children should not be made to go onto the next stage if:

7) **they are not ready.**
8) **they are not confident.**

Children should be encouraged to approximate their answers before calculating.
Children should be encouraged to check their answers after calculation using an appropriate strategy.
Children should be encouraged to consider if a mental calculation would be appropriate before using written methods.