# Cantrell Primary School


# Calculation Policy 2017

Our overall aim is that when children leave Cantrell Primary School, at the end of Year 6, 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 bigger numbers;
- make use of diagrams and informal notes to help record steps and part answers when using mental methods that generate more information than can be kept in their heads;
- have an efficient, reliable, compact written method of calculation for each operation that children can apply with confidence when undertaking calculations that they cannot carry out mentally;
- Identify links between operations, manipulate numbers with confidence, apply skills to a range of problems.

**Introduction**

Children are introduced to the processes of calculation through practical, oral and mental activities. As children begin to understand the underlying ideas they develop ways of recording to support their thinking and calculation methods, use particular methods that apply to special cases, and learn to interpret and use the signs and symbols involved. Over time children learn how to use models and images, such as empty number lines, to support their mental and informal written methods of calculation.

By the end of Year 6 children are equipped with mental, written and calculator methods that they understand and can use correctly. When faced with a calculation, children are able to decide which method is most appropriate and have strategies to check its accuracy.

**Mental methods of calculation**

Oral and mental work in mathematics is essential, particularly so in calculation. Early practical, oral and mental work must lay the foundations by providing children with a good understanding of how the four operations build on efficient counting strategies and a secure knowledge of place value and number facts. Later work must ensure that children recognise how the operations relate to one another and how the rules and laws of arithmetic are to be used and applied. Ongoing oral and mental work provides practice and consolidation of these ideas. It must give children the opportunity to apply what they have learned to particular cases, exemplifying how the rules and laws work, and to general cases where children make decisions and choices for themselves.

**Written methods of calculation**

The aim is that by the end of Key Stage 2, children should be able to use an efficient written method for each operation with confidence and understanding. This guidance promotes the use of what are commonly known as 'standard' written methods – methods that are efficient and work for any calculations, including those that involve whole numbers or decimals. They are compact and consequently help children to keep track of their recorded steps. 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. We want children to know that they have such a reliable, written method to which they can turn when the need arises.

**By the end of F2 we expect that the children are able to know and recall:**

- Count reliably to 20.
- Order numbers 1 – 20.
- Say 1 more/1 less to 20.
- Add & subtract two single digit numbers.
- Solve problems including halving and doubling.

**By the end of Year 1 we expect that the children are able to know and recall:**

**Mentally**

•number pairs totalling 10 (eg 3 + 7 = 10 or 3 + ? = 10)
•addition facts for digits up to 5 (eg 2+ 3 or 3 + 4)
addition doubles up to 5 + 5

**Addition/Subtraction/Multiplication/Division - Calculating**

- 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.
- 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.

## By the end of Year 2 we expect that the children are able to know and recall:

**Mentally**

- addition and subtraction facts for all numbers up to 10 (eg 3 + 5 or 9 – 4)
- number pairs totalling 20
- pairs of '10' numbers totalling 100 (eg 40 + 60 = 100)
- Know all doubles up to 10 + 10
- multiplication and division facts for 2, 5, 10 x tables

**Addition/Subtraction/Multiplication/Division - Calculating**

- solve problems with addition and subtraction: using concrete objects and pictorial representations, including those involving numbers, quantities and measures
- 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.
- 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.

## By the end of Year 3 we expect that the children are able to know and recall:

**Mentally**

- addition and subtraction facts for all numbers up to 20
- addition and subtraction of 'ten' numbers (eg 50 + 80 or 120 – 90)
- know what must be added to any 2 digit number to make next ten' number (eg 56 + ? = 60)
- doubles of 'ten' numbers and related halves (eg 20 + 20 or half of 70)
- pairs of two digit numbers with a total of 100, eg 32 + 68
- recall and use multiplication and division facts for the 3, 4 and 8 multiplication tables

**Addition/Subtraction/Multiplication/Division - Calculating**

- 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.
- 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.

## By the end of Year 4 we expect that the children are able to know and recall:

Mentally

• addition and subtraction of any 'ten' or 'hundred' number (eg 70 + 50 or 800 – 400)

•what must be added to any three digit number to make the next multiple of 100, eg. 521 + ? = 600

•doubles of any 2 digit numbers, and corresponding halves

•multiplication and division facts for all times table up to 12 x 12 tables

•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

Addition/Subtraction/Multiplication/Division - Calculating

- 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.
- 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.

## By the end of Year 5 we expect that the children are able to know and recall:

Mentally

- know what must be added to any 3 digit number to make next 'hundred' number (eg 456 + ? = 500)
- addition and subtraction of decimals to 1 place (eg 3.6 + 5.8 or 7.3 – 2.6)
- doubles and halves of decimals to one place (eg half of 5.6 or double 2.4)
- know what must be added to any decimal to one place to make next 'whole ' number (eg 5.6 + ? = 6)
- know what must be added to any 4 digit 'tens' number to make next 'thousand' number (eg 4560 + ? = 6000)
- multiply and divide whole numbers and those involving decimals by 10, 100 and 1000

Addition/Subtraction/Multiplication/Division - Calculating

- add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction)
- solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why.
- identify multiples and factors, including finding all factor pairs of a number, and common factors of two numbers
- 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
- 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

## By the end of Year 6 we expect that the children are able to know and recall:

**Mentally**

• addition and subtraction facts for any 3 digit 'ten' numbers (eg 230 + 470 or 620 – 450)

•know what must be added to any decimals (2 places) to make next 'whole' number (eg 4.26 + ? = 5)

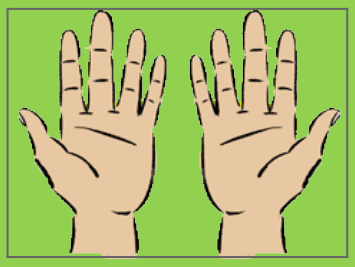
•squares numbers to 12x 12 and corresponding 'ten' numbers (eg 40x40)

**Addition/Subtraction/Multiplication/Division - Calculating**

- 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
- 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

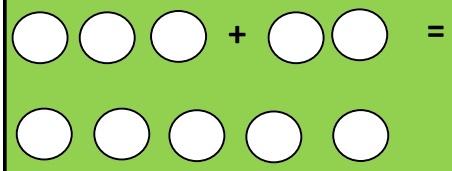
# Addition

***Stage 1*** Counting using fingers and objects



***Stage 2*** Pictorial with pictures or counters

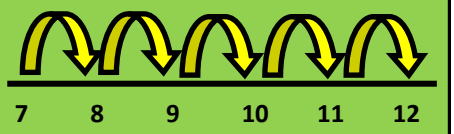
**3 + 2 = 5**




***Stage 3***

Using number lines (single jumps)

**7 + 5 = 12**



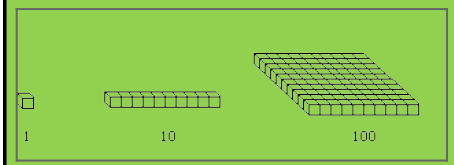

***Stage 4***

***Counting in tens and units***

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 |
| 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 |
| 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 |
| 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |

***Stage 5***

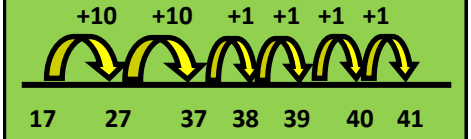
*Practically using units, tens and hundreds equipment. i,e dienes, place value counters, cuisenaire*




***Stage 6***

Number line with jumps in 10s (T) and 1s (U)

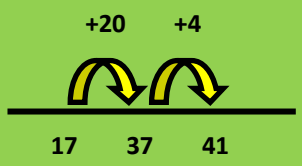
**17 + 24 = 41**



## *Stage 7*

Number line with partitioning

**17 + 24 = 41**




## *Stage 8*

Column addition without carrying

$$\begin{array}{r} 45 \\ +\ 32 \\ \hline 77 \end{array}$$

## *Stage 9*

Partitioning into hundreds (H) tens (T) and units (U)

**123 + 168 = 291**

123 + 168

3 + 8 = 11

20 + 60 = 80

100 + 200 = 200

291

## *Stage 10*

Column addition (by partitioning)

$$\begin{array}{rl} & 123 \\ + & 168 \\ \hline & 11\ (\ 3 + 8)\ \text{(Units)} \\ + & 80\ (\ 20 + 60)\ \text{(Tens)} \\ & 200\ (100 + 100)\ \text{(Hundreds)} \\ \hline & 291 \end{array}$$

## *Stage 11*

Column addition (with carrying)

**123 + 168 = 291**

$$\begin{array}{r} 123 \\ +\ 168 \\ \hline 291 \\ {\scriptstyle 1} \end{array}$$

It is important to remember that the number carried isplaced above the columns (top) or on the *doorstep* (below)

## *Stage 12*

Decimal addition

When adding decimals, it is vital that place value is used and place holders are put in **empty columns.**

**14.8 + 7.65 = 22.45**

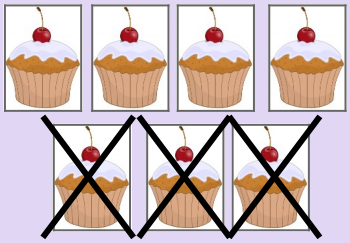
$$\begin{array}{r} 14.8\mathbf{0} \\ +\ \mathbf{0}7.65 \\ \hline 22.45 \\ {\scriptstyle 1\ \ 1} \end{array}$$

# Subtraction

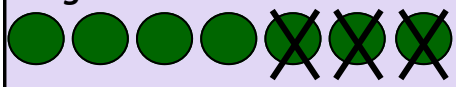
***Stage 1— Songs and counting***

***Stage 2***

Pictorial **7—3 = 4**



***Stage 3***



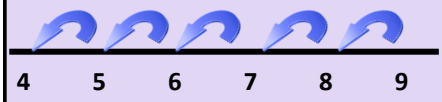
Pictorial with counters

**7—3 = 4**

***Stage 4***

Using number lines (single jumps)

**9—5 = 4**



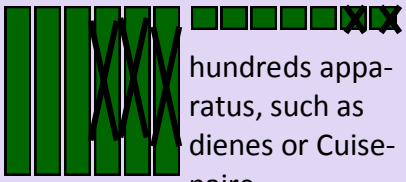
**4 5 6 7 8 9**

***Stage 5—counting up or back in tens and units.***

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 |
| 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 |
| 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 |
| 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |

***Stage 6***

Practically using units, tens and



hundreds apparatus, such as dienes or Cuisenaire.

**67—32 = 35**

***Stage 7***

Using number lines (with appropriate jumps back)

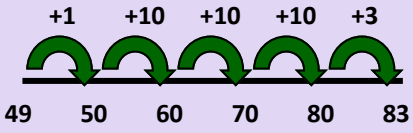

**32 37 47 57 67**

**67—35 = 32**

## *Stage 8*

'Shop Keeper's Method' Counting on.

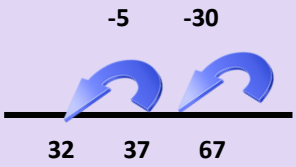
**83—49 = 34**




## *Stage 9*

Using number lines (with partitioned jumps back)

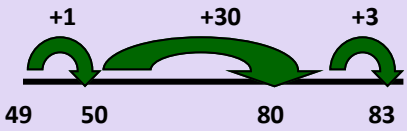
**67—35 = 32**




## *Stage 10*

'Shop Keeper's Method' Counting on.

**83—49 = 34**




## *Stage 11*

Vertical method (without exchanging)

| | T | U |
|---|---|---|
| | 7 | 8 |
| - | 3 | 6 |
| | **4** | **2** |

## *Stage 12*

Through expanded decomposition, then Decomposition (exchanging)

| H | T | U |
|---|---|---|
| ~~$^{0}1$~~ | ~~$^{12}3$~~ | $^{1}2$ |
| | 7 | 8 |
| **0** | **5** | **4** |

## *Stage 13*

Decimal subtraction

By now, children should be secure in using decomposition (stage 10) to subtract 2 numbers. When subtracting decimals (money, measurement etc) they need to be careful and use place value correctly.

# Multiplication

***Stage 1***

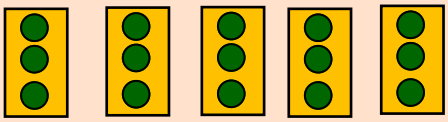
**Songs and counting in 2s, 5s and 10s**

***Stage 2***

Repeated addition using pictorial representation.

**3 x 5 = 15**

3 + 3 + 3 + 3 + 3 = 15



***Stage 3—Using a 100 square to count in 3s, 4s etc***

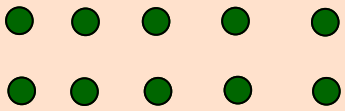
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 |
| 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 |
| 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 |
| 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |

***Stage 4***

Representation as array

**2 x 5 = 10**

**5 x 2 = 10**



***Stage 5***

Multiplication Tables Facts

**7 x 4 = 28**

**Including zero 0 x 4 = 0**

**0 4 8 12 16 20 24 28**

***Stage 6***

Mental methods using partitioning

**16 x 4**

(10 x 4) + (6 x 4)

( 40 ) + ( 24 ) = 64

( Tens ) + (Units)

## *Stage 7*

Grid Method

**16 x 4 = 64**

| x | 10 | 6 |
|---|---|---|
| 4 | 40 | 24 |

**40**
**+** 24

This is TU x U, we use this method to then calculate HTU x U

## *Stage 8*

Column multiplication (with partitioning)

**16 x 4 = 64**

16
**x** 4
24 (Units 6 x 4)
**+** 40 (Tens 10 x 4)
64

## *Stage 9*

Column multiplication (compact)

**16 x 4 = 64**

16
x 4
64
2

## *Stage 10*

Once the products in the boxes have been solved, then the totals can be worked out (either horizontally or vertically)

| x | 20 | 3 | 690 |
|---|---|---|---|
| 30 | 600 | 90 | 161 |
| 7 | 140 | 21 | 851 |

## *Stage 11*

Column multiplication (compact)

TU x TU **23 x 37 = 851**

23
x 37
161
+ 690 (Tens column)
851

## *Stage 12*

Multiplying decimals

You can also use the grid method for multiplying decimals. As long as you remember the **place value**!

| x | 7 | 0.9 |
|---|---|---|
| 6 | 42 | 5.4 |

# Division

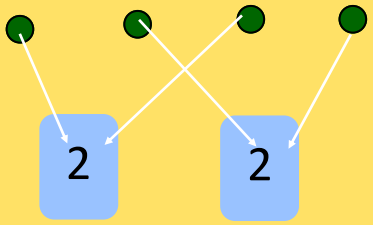
***Stage 1***

Sharing and halving of shapes and objects, using practical activities, songs, role play etc

***Stage 1***

Sharing ( ÷)

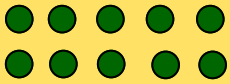
**4 ÷ 2 = 2**




***Stage 2***

Grouping using equipment

**10 ÷ 2 = 5**



Grouping counters in chunks of 3s— and then seeing how many groups there are.

***Stage 3***

Knowing multiplication tables (including x10 and x100)

**The Inverse**

6 x 10 = 60 therefore
60 ÷ 10 = 6 and
60 ÷ 6 = 10

***Stage 4***

**78 ÷ 6 = 13**

**Mental division using partitioning.**

**78 ► 60 + 18**
**60 ÷ 6 = 10**
**18 ÷ 6 = 3**

**1 3**

***Stage 5***

Short Division TU ÷ U

72 ÷ 6 = 12

1 2
6 ) 7 2
1

How many 6s in 7? 1 remainder 1 and then how many 6s in 12? 2

***Stage 5***

Short Division HTU÷U

195 ÷ 5

$$5\overline{)\,1^{1}9^{4}5}\quad 0\,3\;9$$

**We always check with the inverse—so, 39 x 5 = 195**

***Stage 6***

Short division with remainders

**72 ÷ 5 = 14r2**

$$5\overline{)\,7^{2}2}\quad 1\,4\;\;r\,2$$

***Stage 7***

Long division with TU (expanded)

192 ÷ 12 = 16

$$12\overline{)\,192}\quad 016$$

$$-\,120\;(\times 10)$$

$$72$$

$$-\;\;72\;\;(\times 6)$$

***Stage 8***

Long division with TU (compact)

192 ÷12 = 16

$$12\overline{)\,192}\quad 0\,1\,6$$

12 goes into 1 zero times, so we carry it to the 9; 12 goes into 19 once, then we carry the remaining 7 to the 2; 12 goes into 72 six times. When appropriate include remainders.

***Stage 9***

For level 5 and above, children are expected to be able to convert the remainder into a fraction or decimal. So, if the remainder is 2 (stage 6), they would need to know that it is 2/5 two fifths as they were dividing by 5. They can easily convert 2/5 to a decimal or even a percentage.
Also round remainders up or down in context of the problem.

**Throughout all stages of Addition/Subtraction/ Multiplication and Division**

Relate the four operations, understand and use the inverse. Develop mental strategies such as doubling , halving, x by 10, 100, 1000 etc. Develop ways to manipulate numbers and solve problems including missing number problems. Give as many opportunities as possible to apply skills to problems. Use links between areas of Maths as much as possible i.e link fractions to division.