

All Saints Upton

Policy for Written Calculations

Contents

Page number

3	Introduction
4	Whole school approach
6	Stages in Addition
7	Stages in Subtraction
8	Stages In Multiplication
10	Stages in Division
13	Informal to standard written calculations
14	Summary

Progression towards a standard written method of calculation

INTRODUCTION

The National Numeracy Strategy provides a structured and systematic approach to teaching number. There is a considerable emphasis on teaching mental calculation strategies. Up to the **age of 9** (Year 4) informal written recording should take place regularly and is an important part of learning and understanding. **More formal written methods** should follow **only** when the child is able to use a wide range of mental calculation strategies.

REASONS FOR USING WRITTEN METHODS

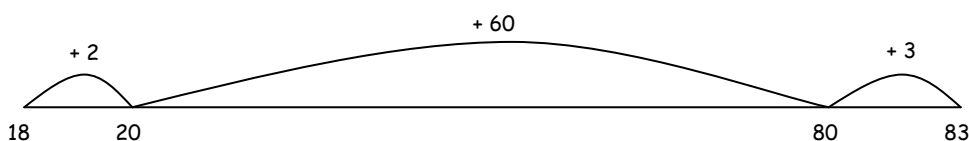
- To aid mental calculation by writing down some of the numbers and answers involved
- To make clear a mental procedure for the pupil
- To help communicate methods and solutions
- To provide a record of work to be done
- To aid calculation when the problem is too difficult to be done mentally
- To develop and refine a set of rules for calculation

All Saints Upton Primary School - Whole School Approach

We have developed a consistent approach to the teaching of written calculation methods. This will establish continuity and progression throughout the school.

Mental methods will be established. These will be based on a solid understanding of place value in number and will include the following:

- i. Remembering number facts and recalling them without hesitation
e.g. pairs of numbers which make 10
Doubles & halves to 20
- ii. Using known facts to calculate unknown facts
e.g. $6 + 6 = 12$ therefore $6 + 7 = 13$
 $24 + 10 = 34$ therefore $24 + 9 = 33$
- iii. Understanding and using relationships between addition & subtraction to find answers and check results
e.g. $14 + 6 = 20$ therefore $20 - 6 = 14$
- iv. Having a repertoire of mental strategies to solve calculations
e.g. doubles / near doubles
bridging 10 / bridging 20
adding 9 by +10 & -1
- v. Making use of informal jottings such as blank number lines to assist in calculations with larger numbers *e.g. $83 - 18 = 65$*



- vi. Solving one-step word problems (either mentally or with jottings) by identifying which operation to use, drawing upon their knowledge of number bonds and explaining their reasoning
- vii. Beginning to present calculations in a horizontal format and explain mental steps using numbers, symbols or words
- viii. Learn to estimate/approximate first e.g. $29 + 30$ (round up to nearest 10, the answer will be near to 60).

Place value will be taught mentally first from Reception class where number tracks are used, progressing to number lines (to 10 or 20 as appropriate) in Years 1 and 2. The empty number line will then be introduced to aid calculations.

Subtraction will be taught by counting on and counting back depending on the numbers.

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 time table
- Do they know the result of multiplying by 0 and 1?
- Do they understand 0 as a placeholder?
- 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?

The above lists are not exhaustive but are a guide for the teacher to judge when a child is ready to move from informal to formal methods of calculation.

Stages in Addition

1. Mental method, using partitioning:

$$47 + 76 = (40 + 70) + (7 + 6)$$

or

$$47 + 76 = (47 + 70) + 6$$

2. Introduction to vertical layout, using partitioning

$$\begin{array}{r} 300 + 70 + 8 \\ 400 + 80 + 7 \\ \hline 700 + 150 + 15 = 865 \\ \hline \end{array}$$

3. Vertical layout, expanded working, adding the least significant digit first:

$$\begin{array}{r} 47 \\ + 76 \\ \hline 13 \\ 110 \\ \hline 123 \end{array} \qquad \begin{array}{r} 368 \\ + 493 \\ \hline 11 \\ 150 \\ 700 \\ \hline 861 \end{array}$$

4. Vertical layout, contracting the working to a compact efficient form:

$$\begin{array}{r} 47 \\ + 76 \\ \hline 13 \\ 110 \\ \hline 123 \end{array} \qquad \begin{array}{r} 47 \\ + 76 \\ \hline 123 \\ \hline 11 \end{array} \qquad \begin{array}{r} 368 \\ + 493 \\ \hline 11 \\ 150 \\ 700 \\ \hline 861 \end{array} \qquad \begin{array}{r} 368 \\ + 493 \\ \hline 861 \\ \hline 11 \end{array}$$

5. Bigger numbers and decimals

Stages in Subtraction by Decomposition

1. $563 - 241$

$$\begin{array}{r}
 500 \quad 60 \quad 3 \\
 - 200 \quad 40 \quad 1 \\
 \hline
 300 \quad 20 \quad 2 = 322 \\
 \hline
 \end{array}$$

leading to

$$\begin{array}{r}
 5 \quad 6 \quad 3 \\
 - 2 \quad 4 \quad 1 \\
 \hline
 3 \quad 2 \quad 2 \\
 \hline
 \end{array}$$

2. $563 - 278$

$$\begin{array}{r}
 500 \quad 60 \quad 3 \quad \rightarrow \quad 400 \quad 150 \quad 13 \\
 - 200 \quad 70 \quad 8 \quad \rightarrow \quad -200 \quad 70 \quad 8 \\
 \hline
 200 \quad 80 \quad 5 = 285 \\
 \hline
 \end{array}$$

leading to

$$\begin{array}{r}
 {}^4\cancel{5} \quad {}^{15}\cancel{6} \quad 13 \\
 - 2 \quad 7 \quad 8 \\
 \hline
 2 \quad 8 \quad 5 \\
 \hline
 \end{array}$$

Stages in Multiplication

1. Mental method using partitioning multiplying tens first: 38×7

$$38 \times 7 = (30 \times 7) + (8 \times 7) = 210 + 56 = 266$$

2. Grid layout 38×7

x	30	8	
7	210	56	266

3. Grid layout - extend to bigger numbers i.e. 238×7

x	200	30	8	
7	1400	210	56	1666

Extend to ThHTU

4. Extend to bigger numbers: 56×27

$$56 \times 27 = (50 + 6) \times (20 + 7)$$

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

5. Vertical format, expanded working, least significant digits first.

$$\begin{array}{r} 38 \\ \times 7 \\ \hline 56 \quad (8 \times 7) \\ 210 \quad (30 \times 7) \\ \hline 266 \end{array}$$

Extend to HTU \times U

The following should only be used for the very able, if at all.

6. Long multiplication

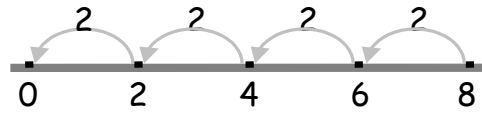
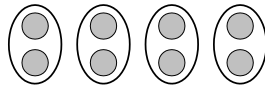
$$\begin{array}{r} 56 \\ \times 27 \\ \hline 1000 \quad (50 \times 20) \\ 120 \quad (6 \times 20) \\ 350 \quad (50 \times 7) \\ 42 \quad (6 \times 7) \\ \hline 1512 \end{array}$$

7. Vertical format, compact working

$$\begin{array}{r} 56 \\ \times 27 \\ \hline 1120 \quad (56 \times 20) \\ 392 \quad (56 \times 7) \\ \hline 1512 \\ \hline 1 \end{array}$$

Stages in Division

1. Number lines & grouping



2. Informal methods using multiples of the divisor or 'chunking' $TU \div U$

$72 \div 5$		72	
	$5 \times 10 = 50$	<u>-50</u>	
		22	
	$5 \times 4 = 20$	<u>-20</u>	
Answer: 14 r 2	14	2	

3. 'Chunking' $HTU \div U$

$256 \div 7$		256	
	$7 \times 10 = 70$	<u>-70</u>	
Approximate answer		186	
$280 \div 7 = 40$	$7 \times 20 = 140$	<u>-140</u>	
		46	
	$7 \times 6 = 42$	<u>-42</u>	
Answer: 36 r 4	36	4	

4. Efficient 'chunking' $HTU \div U$

$196 \div 6$		196	
	$6 \times 30 = 180$	<u>-180</u>	
Approximate answer		16	
$180 \div 6 = 30$	$6 \times 2 = 12$	<u>-12</u>	
Answer: 32 r 4	32	4	

5. Extend to decimals with up to 1 place

$87.5 \div 7$		87.5
	$7 \times 10 = 70.0$	<u>$- 70.0$</u>
Approximate answer		17.5
$84 \div 7 = 12$	$7 \times 2 = 14.0$	<u>$- 14.0$</u>
		3.5
	$7 \times 0.5 = 3.5$	<u>$- 3.5$</u>
Answer: 12.5	12.5	0

6. 'Chunking' HTU \div TU

$560 \div 24$		560
	$24 \times 10 = 240$	<u>$- 240$</u>
Approximate answer		320
$550 \div 25 = 22$	$24 \times 10 = 240$	<u>$- 240$</u>
		80
	$24 \times 2 = 48$	<u>$- 48$</u>
		32
	$24 \times 1 = 24$	<u>$- 24$</u>
Answer: 23 r 8	23	8

7. Efficient chunking HTU \div TU

$560 \div 24$		560
	$24 \times 20 = 480$	<u>$- 480$</u>
Approximate answer		80
$550 \div 25 = 22$	$24 \times 3 = 72$	<u>$- 72$</u>
	23	8

8. Extending to an efficient standard method

$$560 \div 24$$

	24)	560
Approximate answer:	20	<u>-480</u>
$560 \div 25 = 22$		80
	3	<u>-72</u>
Answer 23 r 8	23	8

Extend to decimals with up to 2 decimal places

Informal to Standard Written Calculations

As a general rule the majority of the class should cover these stages, **in this order**, during Key Stage 2. If a child cannot grasp a method, **go back** & consolidate the previous method before trying again.

	Addition	Subtraction	Multiplication	Division
Y 3	TU + TU developing to HTU + TU or HTU + HTU 1. Use of number lines to count on 2. Horizontal expanded method, using partitioning 3. Vertical expanded method adding most (or least) significant digit first	TU – TU, developing to HTU – TU or HTU – HTU 1. Use of number line to count up 2. Use of number line to take too much & add back 3. Use of partitioned vertical form (expanded form) 4. Decomposition using expanded form	No written methods Repeated addition Describing an array Scaling	No written methods Grouping Sharing Remainders
Y 4	HTU + TU then HTU + HTU 1. Vertical expanded method adding most significant digit first 2. Vertical expanded method adding least significant digit first 3. Leading to 'carrying' below the line 4. Calculations extended to include addition of two or more 3-digit sums of money	HTU – TU then HTU – HTU 1. Decomposition using expanded form 2. Decomposition using compact form 3. Calculations extended to include the difference between two 3-digit sums of money	TU x U 1. Grid method (TU x U) 2. Standard expanded short multiplication (TU x U) leading to 3. Compact short multiplication (TU x U)	TU ÷ U 1. TU ÷ U using chunking
Y 5	HTU + HTU then ThHTU + ThHTU 1. Vertical expanded method adding least significant digit first 2. Compact written method 'carrying' below the line 3. Calculations extended to include addition of two or more decimal fractions, with up to three digits & the same number of decimal places, in vertical format	HTU – HTU, then ThHTU – ThHTU 1. Decomposition using expanded form 2. Decomposition using compact form 3. Calculations extended to include subtraction of decimals, with up to 3 digits & the same number of decimal places, in expanded format leading to vertical format	HTU x U, & TU x TU 1. Grid method (HTU x U & TU x TU) 2. Standard expanded short multiplication (HTU x U) leading to 3. Compact short multiplication (HTU x U) 4. Long multiplication (TU x TU) 5. Calculations extended to include multiplying decimal fractions with one decimal place by a single digit	HTU ÷ U 1. HTU ÷ U using chunking 2. HTU ÷ U - efficient chunking
Y 6	ThHTU + ThHTU & then any number of digits 1. Compact written method 'carrying' below the line 2. Calculations extended to include addition of two or more decimal fractions with up to four digits & either one or two decimal places	ThHTU – ThHTU & then any number of digits 1. Decomposition using compact form 2. Calculations extended to include subtraction of two or more decimal fractions with up to 3 digits & either one or two decimal places in vertical format	ThHTU x U & HTU x TU 1. Grid method (ThHTU x U & HTU x TU) 2. Standard expanded short multiplication (ThHTU x U) leading to 3. Compact short multiplication (ThHTU x U) 4. Long multiplication (HTU x TU) 5. Calculations extended to include multiplying decimal fractions with two decimal places by a single digit	HTU ÷ TU 1. HTU ÷ TU using chunking 2. HTU ÷ TU – efficient chunking 3. HTU ÷ TU – efficient standard method 4. Extend to decimal fractions with up to two decimal places

Summary

- children should always estimate first
- always check the answer, preferably using a different method eg. the inverse operation
- always decide first whether a mental method is appropriate
- pay attention to language - refer to the actual value of digits
- children who make persistent mistakes should return to the method that they can use accurately until ready to move on
- children need to know number and multiplication facts by heart
- discuss errors and diagnose problem and then work through problem - do not simply re-teach the method
- when revising or extending to harder numbers, refer back to expanded methods. This helps reinforce understanding and reminds children that they have an alternative to fall back on if they are having difficulties.