Policy for Written Calculations

Contents

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

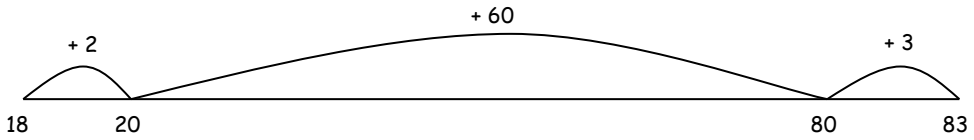
- To aid mental calculation by writing down some of the numbers/answers involved
- To make clear a mental procedure for the pupil
- To help communicate methods and solutions
- To provide a record of work done
- To aid calculation when the problem is too difficult to be done mentally
- To develop and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

Fern Hill 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 children will be taught to use a range of models e.g. number tracks, place value cards, pictorially, 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 (i.e. finding the difference) depending on the numbers.

Numbers such as 10, 100, 1000 will be called Landmark 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:

* *Always set the sum out with the biggest number first*
** *In your head, add the hundreds, tens and then units.*

76 + 47 = (70 + 40) + (6 + 7) 487 + 328 = (400 + 300) + (80 + 20) + (7 + 8)
or
76 + 47 = (76 + 40) + 7

2. Introduction to written vertical layout, using partitioning

70	+	6		400	+	80	+	7
40	+	7		300	+	20	+	8
110	+	13	= 123	700	+	100	+	15 = 815

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

76		76		487		487	
+ 47		+ 47		+ 328		+ 328	
110	*Adding Tens first*	13	*Adding Units first*	700		15	
13		110		150		150	
123		123		15		700	
				865		865	

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

47	47	378	378
+ 76	+ 76	+487	+487
13	123	15	865
110	1 1	150	1 1
123		700	
		865	

5. Bigger numbers and decimals

Stages in Subtraction by Decomposition

1. 563 - 241

	500	60	3	
-	200	40	1	
	300	20	2	= 322

leading to

	H	T	U
	5	6	3
-	2	4	1
	3	2	2

Remind children of the need to subtract the least significant digit first, just as with addition – it is particularly important when borrowing.

2. 563 - 278

	400	150 ~~50~~	13 ~~3~~	→		400	150	13	
	~~500~~	~~60~~							
-	200	70	8	→	_	200	70	8	
						200	80	5	= 285

leading to

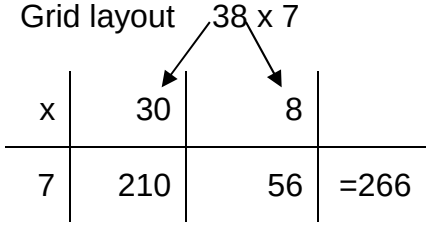
	4 ~~5~~	15 ~~6~~	1 3	
-	2	7	8	
	2	8	5	

Stages in Multiplication

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

   38 x 7 = (30 x 7) + (8 x 7) = 210 + 56 = 266

2. Grid layout 38 x 7



x	30	8	
7	210	56	=266

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

x	200	30	8	
7	1400	210	56	=1666

Extend to ThHTU

4. Extend to bigger numbers: 56 x 27

   56 x 27 = (50 + 6) x (20 + 7)

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

5. Vertical format, expanded working, moving on to standard column multiplication.

a)
```
   38
x   7
  210  (30x7)
   56  (8x7)
  266
```

b)
```
   38
x   7
  266
   5
```

Extend to HTU x U

Long multiplication

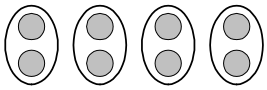
```
    56
x   27
  1000   (50 x 20)
   120   (6 x 20)
   350   (50 x 7)
    42   (6 x 7)
  1512
```

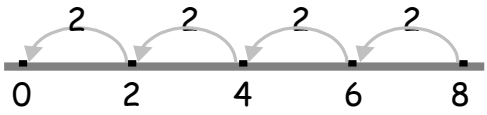
6. Vertical format, compact working, showing carrying.

```
    Th H T U
        5 6
x       2 7
      3 9 2     (56 x 7)
        4
+   1 1 2 0   (56 x 20)
      1
    1 5 1 2
      1
```

Stages in Division

1. Number lines & grouping





2. Informal methods using multiples of the divisor or 'chunking' TU ÷ U

72 ÷ 5	72	
	- 50	(5 x 10)
	22	
	- 20	(5 x 4)
Answer: 14 r 2	2	14

3. 'Chunking' HTU ÷ U

256 ÷ 7	256	
	- 70	(7 x 10)
Approximate answer	186	
280 ÷ 7 = 40	- 140	(7 x 20)
	46	
	- 42	(7 x 6)
Answer: 36 r 4	4	36

4. Efficient 'chunking' HTU ÷ U

256 ÷ 7	256	
	- 210	(7 x 30)
Approximate answer	46	
280 ÷ 7 = 40	- 42	(7 x 6)
Answer: 36 r 4	4	36

5. Extend to decimals with up to 1 place

87.5 ÷ 7	87.5	
	- 70.0	(7 x 10)
Approximate answer	17.5	
84 ÷ 7 = 12	- 14.0	(7 x 2)
	3.5	
	-3.5	(7 x 0.5)
Answer: 12.5	0	12.5

6. 'Chunking' HTU ÷ TU

560 ÷ 24	560	
	- 240	(24 x 10)
Approximate answer	320	
550 ÷ 25 = 22	- 240	(24 x 10)
	80	
	-48	(24 x 2)
	32	
	-24	(24 x 1)
Answer: 23 r 8	8	23

7. Efficient chunking HTU ÷ TU

560 ÷ 24	560	
	- 480	(24 x 20)
Approximate answer	80	
550 ÷ 25 = 22	-72	(24 x 3)
Answer: 23 r 8	8	23

8. Extending to an efficient standard method of HTU ÷ U

560 ÷ 4

		140	
		1	
	4)	560	
		-400	(4 x 100)
		160	
		-160	(4 x 40)
Answer 140 r 0		0	140

9. Extending to an efficient standard method of HTU ÷ TU

560 ÷ 24

		23 r 8	
		8	
	24)	560	
Approximate answer:		-480	(24 x 20)
550 ÷ 25 = 22		80	
		-72	(24 x 3)
Answer 23 r 8		8	23

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 ÷ U – efficient standard method 4. HTU ÷ TU – efficient standard method 5. 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.