Policy for Written Calculations

One Team Together

Staincliffe Junior School

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 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

A useful written method is one that helps children to carry out a calculation and can be understood by others.

Written recording is needed to help us to keep track of where we are in our calculation and to help explain our method or thinking to someone else.

It is important to encourage children to look at the problem and decide which is the best method to choose.
Pictures
Mental
Mental with jottings
Structured recording
Calculator

This policy shows a developmental path through written calculations. Not all children will follow the route at the same speed. Some children will need lots of reinforcement of the previous year group and some children may move quicker than expected onto the next year group. It is important to move at the pace of the child and not rush them through written methods without full understanding.

Where possible written methods will be practised through real life problems and opened up to include problem solving activities. Children will be given opportunities to explain their reasoning and methods to each other.

Staincliffe 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:

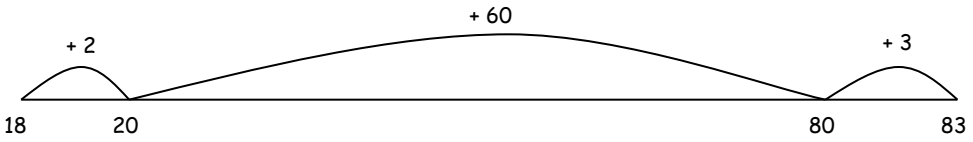
i. Remembering number facts and recalling them without hesitation
e.g. pairs of numbers which make 10
Doubles & halves to 20

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).

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?
- Do they use and apply the commutative and associative laws of addition?

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?
- Do they use the commutative and associative laws for multiplication and the distributive law of multiplication over addition and subtraction?
- Do they recognise that multiplication and division are inverse operations?

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

<u>Year 3</u> Mental methods (using jottings)

Partitioning

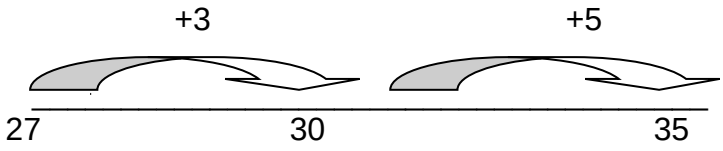
47 + 76 = (40 + 70) + (7 + 6)

or

47 + 76 = (47 + 70) + 6

Using number lines, for example bridging through 10.

27 + 8 = 27 + 3 + 5 =



Developing other mental strategies and recall of number facts.

Introduction to vertical layout, using partitioning

378	300	+ 70	+ 8	
+ 487	400	+ 80	+ 7	
	700	+ 150	+ 15	= 865

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

47	368
76	+ 493
13	11
110	150
123	700
	861

Year 3/4

3547	36.8
+ 4769	+ 49.3
16	1.1
100	15.0
1200	70.0
7000	86.1
8316	

Vertical layout, contracting the working to a compact efficient form, moving from least significant digit first:

47	47	368	368
+ 76	+ 76	+493	+493
13	123	11	861
110	1 1	150	1 1
123		700	
		861	

3547	36.8
+ 4769	+49.3
8316	86.1
1 1 1	1 1

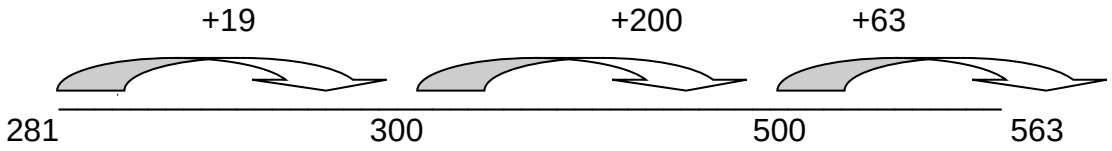
Make sure when adding quantities i.e. grams and kilograms that the quantities are written in the same unit.

Children should have experience of adding more than two sets of numbers and calculations should be practised through word problems including the use of money, decimals and measure.

Stages in Subtraction

<u>Year 3</u> Blank number line method - Finding the difference

563 - 281

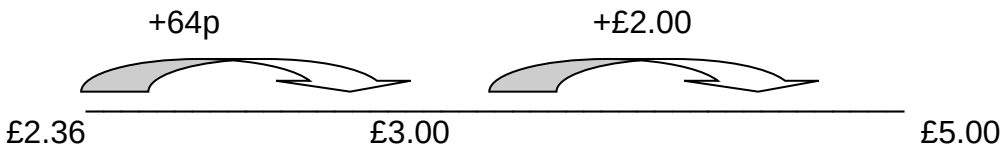


Answer 200 + 63 +19 = 200 +70 +12 = 282

<u>Year 4 and 5</u>

Money

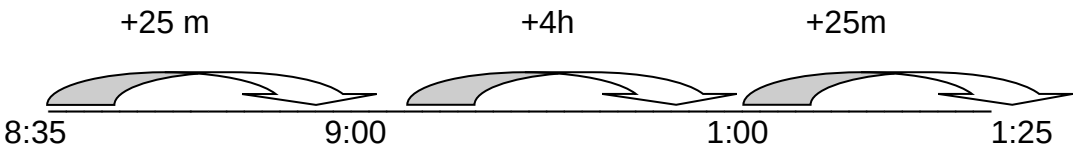
£5 - £2.36



Answer £2.00 + 64p = £2.64

Time

8:35 to 1:25



Answer 4h 50m

Year 6

Standard method used

Stages in Subtraction by Decomposition

Year 3 **563 - 241**

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

563 - 278

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

Year 3/4

Leading to

	$^{4}\cancel{5}$	$^{15}\cancel{6}$	$^{1}3$
-	2	7	8
	2	8	5

Stages in Multiplication

Year 3

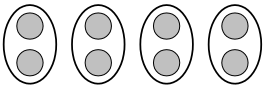
Mental method using partitioning multiplying tens first: 32 x 3

32 x 3 = (30 x3) + (2 x 3) = 90 + 6 = 96

Reinforcement of multiplying by 10 and 100 and the effect this has on the place value of the digits.

6 X 10 = 60
6 X 100 = 600
6 X 20 = 6 X 2 X 10 = 120

Arrays showing links to division



Learning multiplication tables

Year 4 **Grid layout 38 x 7**

x	30	8	
7	210	56	266

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

x	200	30	8	
7	1400	210	56	1666

<u>Year 5</u> 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

<u>Year 6</u> Extend to decimals

5.24 x 6

x	5 .00	0.20	0.04
6	30.00	1.20	0.24
			31.44

Grid method 3 digits x 2 digits

Year 5/6
Standard method

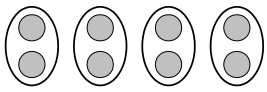
Extend to decimals

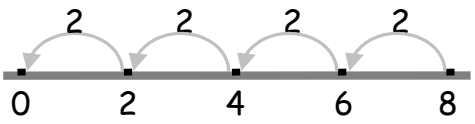
5.24 x 6

3 digits x 2 digits **345 x 26**

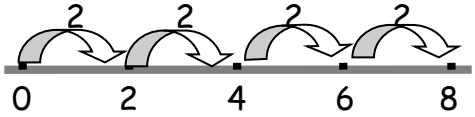
Stages in Division

Year 3 Number lines & grouping

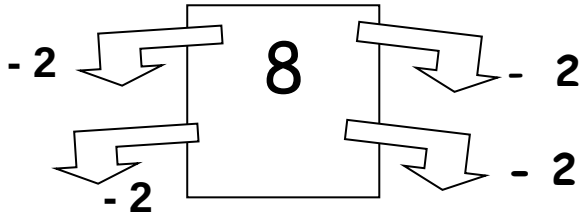




8 ÷ 2 = 8 – 2 – 2 – 2 – 2 =



Division by repeated subtraction – represented by counting back and counting up.



Year 4 **Informal methods using multiples of the divisor or 'chunking' TU ÷ U**

72 ÷ 5

10 + 4 = 14 r 2

5 | 72

-50 (5 x 10)

22

- 20 (5 x 4)

2

Answer 14 r 2

Year 5

256 ÷ 7

30 + 6 = 36 r 4

7 | 256

-210 (7 x 30)

46

-42 (7 x 6)

4

Answer: 36 r 4

Year 6

Decimal numbers 87.5 ÷ 7

10 + 2 + 0.5 = 12.5

7 | 87.5

- 70.0 (7 x 10)

17.5

14.0 (7 x 2)

3.5

-3.5 (7 x 0.5)

Extend to decimals with up to 2 decimal places

3 digits ÷ 2 digits 560 ÷ 24

$$
\begin{array}{r}
20 + 3 = 23 \text{ r } 8 \\
24 \overline{)\ 560} \\
-\ 480 \\
\hline
80 \\
-\ 72 \\
\hline
8
\end{array}
$$

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.

Agreed examples of formal written methods for addition, subtraction, multiplication and division

Addition and subtraction

789 + 642 becomes

$$\begin{array}{r} 7\ 8\ 9 \\ +\ 6\ 4\ 2 \\ \hline 1\ 4\ 3\ 1 \\ \hline 1\ \ 1 \end{array}$$

Answer: 1431

932 – 457 becomes

$$\begin{array}{r} \overset{8}{\cancel{9}}\ \overset{12}{\cancel{3}}\ \overset{1}{2} \\ -\ 4\ 5\ 7 \\ \hline 4\ 7\ 5 \\ \hline \end{array}$$

Answer: 475

Short multiplication

24 × 6 becomes

$$\begin{array}{r} 2\ 4 \\ \times\ \ 6 \\ \hline 1\ 4\ 4 \\ \hline 2 \end{array}$$

Answer: 144

342 × 7 becomes

$$\begin{array}{r} 3\ 4\ 2 \\ \times\ \ 7 \\ \hline 2\ 3\ 9\ 4 \\ \hline 2\ \ 1 \end{array}$$

Answer: 2394

2741 × 6 becomes

$$\begin{array}{r} 2\ 7\ 4\ 1 \\ \times\ \ 6 \\ \hline 1\ 6\ 4\ 4\ 6 \\ \hline 4\ \ 2 \end{array}$$

Answer: 16 446

Long multiplication

24 × 16 becomes

$$\begin{array}{r} 2\ 4 \\ \times\ 1_2\ 6 \\ \hline 2\ 4\ 0 \\ 1\ 4\ 4 \\ \hline 3\ 8\ 4 \\ \hline \end{array}$$

Answer: 384

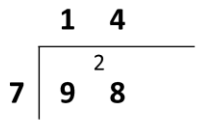
124 × 26 becomes

$$\begin{array}{r} 1\ 2\ 4 \\ \times\ \ {}_1 2_2\ 6 \\ \hline 7\ 4\ 4 \\ 2\ 4\ 8\ 0 \\ \hline 3\ 2\ 2\ 4 \\ \hline 1\ \ 1 \end{array}$$

Answer: 3224

Short division

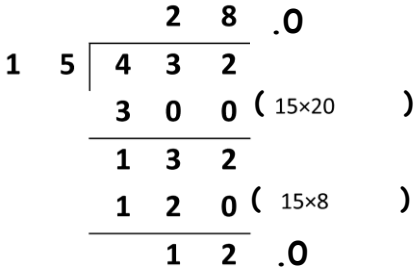
98 ÷ 7 becomes



Answer: 14

Long division

432 ÷ 15 becomes



$\frac{\cancel{12}}{\cancel{15}} = \frac{4}{5}$

Answer: $28\frac{4}{5}$

Standard methods

In order to gain marks in the Y6 SATs tests, pupils will need to be taught standard methods. Below is a suggestion of when they should be taught.

Year 3 – Standard method for addition

Year 4 – As Y3 but to include standard method for subtraction and multiplication

Year 5 – As Y4 but to include standard method for division

Year 6 – Ensure fluency in all standard methods

These methods may not be introduced at the start of the school year, but the children should be taught them (differentiated for ability), within the year. Following years can then build on this.