Hillborough Junior School

Calculation Policy

Adopted: September 2021 Review: Annually

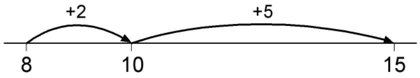
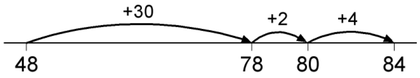
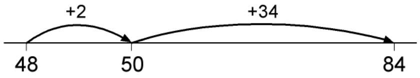
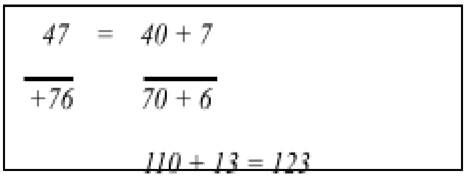
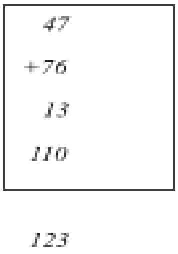
This calculation has been updated yearly in response to the New National Curriculum (published September 2016), and aims to ensure the consistency in the mathematical written methods and approaches to calculation across years 3-6.

This document is organised according to mathematical operation, however it may be necessary for teachers to consult with lower and/or higher year group staff in order for students to reach (and exceed) their age expected standard.

At Hillborough Junior School we have always emphasised the importance of using and applying of what pupils have learnt. Wherever possible, we encourage teachers to create real-life contexts for learning in maths.

As part of pupils learning in calculation, they need to be taught how to select the best method according to the numbers (i.e. numerical efficiency). This knowledge and understanding is important for developing arithmetic skills, as well as being able to apply to real-life problems.

Written methods for addition of whole numbers

Stage 1: The numbered number line	**Stage 2: Partitioning (vertical)**
Steps in addition can be recorded on a number line. The steps often bridge through a multiple of 10. *8 + 7 = 15*  *48 + 36 = 84*  *or:*  	Record steps in addition using partitioning: *e.g. 47 + 76 =* *Tens: 40 + 70 = 110* *Units: 6 + 7 = 13* *Combined: 110 + 13 = 123* Partitioned numbers are then written under one another:  47 = 40 + 7 +76 70 + 6 110 + 13 = 123 NB: This method is used for encouraging pupils to understand that when adding in a column they are still using H, T and U, even though only 1 digit from the place value is written.
Stage 3: Expanded method in columns	**Stage 4: Column method**
Write the numbers in columns. Adding the units first:  47 +76 13 110 123	47 + 76 123 1 1 258 + 87 345 1 1 366 +458 824 1 1 Column addition remains efficient when used with larger whole numbers and decimals. Once learned, the method is quick and reliable. Ensure pupils carry below the line – if pupils carry above the calculation this might cause confusion with subtraction where numbers above the calculation signify that an exchange /

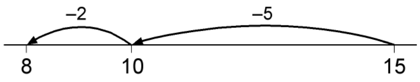
At this time Teachers reinforce the idea to pupils that the ‘4’ and ‘7’ within the question represent tens not units. This encourages the pupil to add the tens as the correct number and place value. This is the final step of ‘written mental methods’ before formal column recording is used (the final step).	adjustment has occurred to allow the calculation to be possible

Written methods for subtraction of whole numbers

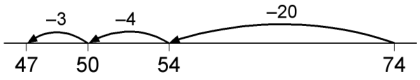
Stage 1: Using numbered number line

Steps in subtraction can be recorded on a number line. The steps often bridge through a multiple of 10.

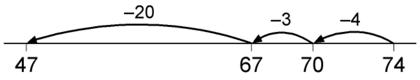
15 – 7 = 8



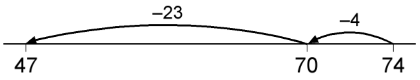
74 – 27 = 47 worked by counting back:



The steps may be recorded in a different order:



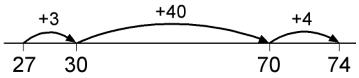
or combined:



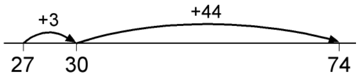
This method shows pupils a method where they can also check their answer by using the inverse.

The counting-up method

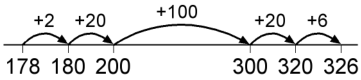
74 – 27 =



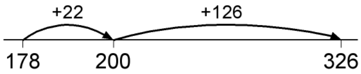
or:



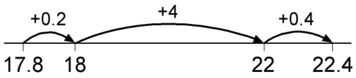
326 – 178 =



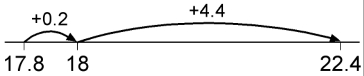
or:



22.4 – 17.8 =



or:



All of these methods once again encourage pupils to use what they know to expand on previous learning and consolidate understanding of number bonds.

Stage 2: Partitioning (the number to be subtracted)

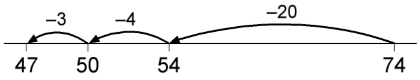
Subtraction can be recorded using partitioning:

74 – 27 =

74 – 20 = 54

54 – 7 = 47

This requires children to subtract a single-digit number or a multiple of 10 from a two-digit number mentally. The method of recording links to counting back on the number line.



Stage 3: Column method

eg.

2362 – 548 =

$$\begin{array}{r} {}^{1}\cancel{2}\;{}^{1}3\;{}^{5}\cancel{6}\;{}^{1}2 \\ -\quad 5\;4\;8 \\ \hline 1\;8\;1\;4 \end{array}$$

72.5 – 45.7 =

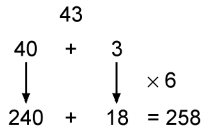
$$\begin{array}{r} {}^{6}\cancel{7}\;{}^{11}\cancel{2}.\;{}^{1}5 \\ -\quad 4\;\;5.\;7 \\ \hline 2\;\;6.\;8 \end{array}$$

This method is the final step and what all pupils should aim to be able to use independently when subtracting large numbers from one another. Similar to column addition, this method is one that is fast, reliable and can be used throughout Key stage 2.

Written methods for multiplication of whole numbers

Stage 1: Mental multiplication using partitioning

Informal recording in Year 3/4 might be:



These small, bite size steps initially ensure that children understand the process of combining numbers when multiplying. Incorporating both multiplication and addition within this method leads to a similar path when they begin to learn long multiplication.

Stage 2: The grid method

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

×	7
30	210
8	56
	266

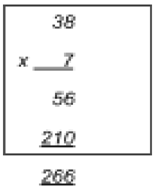
Or

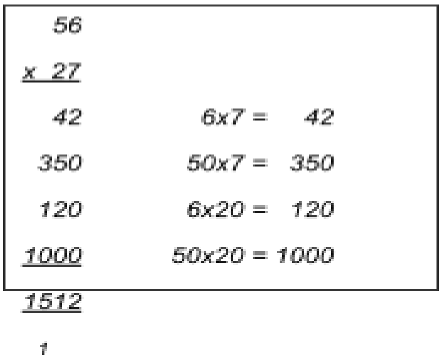
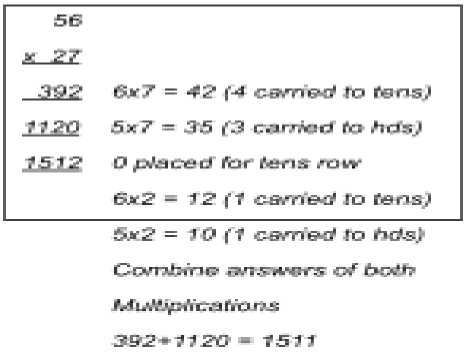
x	30	8
7	210	56

$$\begin{array}{r} 210 \\ +\ 56 \\ \hline 266 \\ \hline \end{array}$$

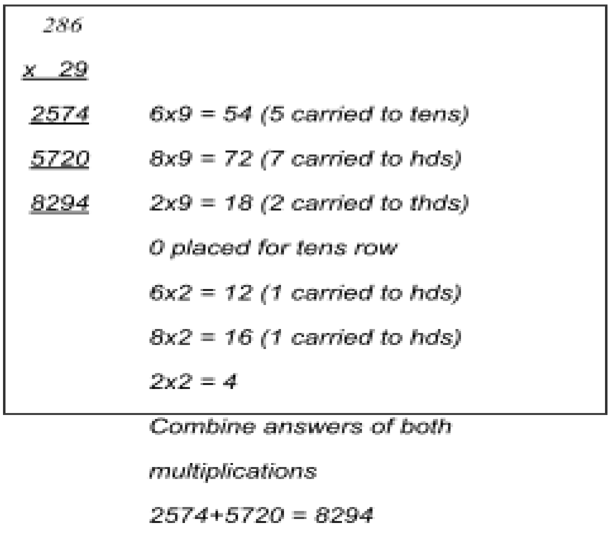
Both of these methods will lead to the same answer and show the same format to pupils. The biggest difference is that the 'vertical' grid enables pupils to go straight into an addition column which will combine the answer of their original multiplication. It is key that pupils understand that even though it seems like a 'one step' solution due to only one formal method being written they are actually multiplying the Tens and Units separately before adding both answers together.

This method can be modified to be used when multiplying two digit by two digit numbers. Once again the same rules apply with the emphasis being that once pupils have multiplied within the correct grid they combine their answers at the end.

	Though not seen as a ‘formal’ method, understanding the grid method is something which is very beneficial when pupils come to advanced operations including algebra and equations.
Stage 3: Expanded short multiplication	**Stage 4: Short multiplication**
 38 x 7 56 210 266 This method develops on the process of multiplying place values separately then combining them. A key element for teachers to focus on is layout in order to make a seamless transition to long multiplication.	38 × 7 266 5 The step here involves pupils recording formally while including the previously taught element of carrying (learnt during column addition). Knowledge of times tables needs to be well developed in order to gain maximum progression to long multiplication. Note: the carrying takes place below the answer, as has been taught in addition and subtraction.
Stage 5: Two-digit by two-digit products	
56 × 27	56 × 27 (formal long multiplication)

<table>
<tr>
<td>
56
x 27
42 6x7 = 42
350 50x7 = 350
120 6x20 = 120
1000 50x20 = 1000
1512
1</td>
<td>
56
x 27
392 6x7 = 42 (4 carried to tens)
1120 5x7 = 35 (3 carried to hds)
1512 0 placed for tens row
6x2 = 12 (1 carried to tens)
5x2 = 10 (1 carried to hds)
Combine answers of both
Multiplications
392+1120 = 1511</td>
</tr>
<tr>
<td colspan="2">Stage 6: Three-digit by two-digit products</td>
</tr>
<tr>
<td>286 × 29 is approximately 300 × 30 = 9000.

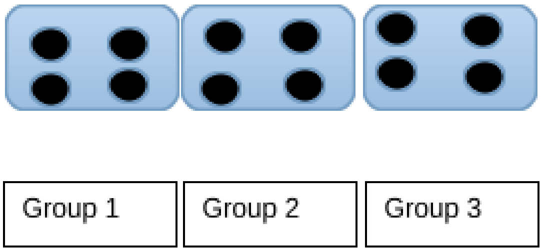
NB: Throughout the teaching of multiplication teachers are advised to make reference to what pupils already know. It is often the case that this will be in the form of estimation using their number bond knowledge.

Though pupils will still need to learn the formal methods this rounding and estimating allows them to have a rough idea of their final calculations.</td>
<td>e.g.

286
x 29
2574 6x9 = 54 (5 carried to tens)
5720 8x9 = 72 (7 carried to hds)
8294 2x9 = 18 (2 carried to thds)
0 placed for tens row
6x2 = 12 (1 carried to hds)
8x2 = 16 (1 carried to hds)
2x2 = 4
Combine answers of both
multiplications
2574+5720 = 8294</td>
</tr>
</table>

Written methods for division of whole numbers

Stage 1: Mental division using resources and prior knowledge	
Mental calculations of any form of division within the lower school would focus around the idea of grouping and sharing. In order to make the process of sharing accessible to the pupils, various resources (e.g. multi-link blocks, cubes etc.) are used as a form of tactile learning.	As pupil's understanding of division continues to develop and improve the clear link between multiplication and division is highlighted more and more (in particular with reference to times tables). This is something which is reinforced throughout the school from Year 3 to Year 6.

For example a teacher may ask: “How can we share these 12 blocks equally into 3 groups?”



For example, pupils who are left with a question such as 49 ÷ 7 may find that without resources there is a lot to remember as they try and group repeatedly. To avoid this confusion a teacher would encourage the pupil to use their times table knowledge and work up to as close to 49 as possible (without exceeding the number). As a possible resource a 100 grid or times table grid could assist the pupil.

This process would lead the pupil to seeing that 49 is in the 7 times table (therefore no remainder) and that 7 goes into 49 7 times exactly, i.e.

49 ÷ 7 = 7.

Stage 2: Short division of TU ÷ U (without, then with remainders)

81÷3

This is then shortened to:

$$\begin{array}{r} 2\ 7 \\ 3\overline{)8\ {}^{2}1} \end{array}$$

The carry digit ‘2’ represents the 2 tens that have been exchanged for 20 ones. The 27 written above the line represents the answer: 20 + 7, or 2 tens and 7 ones.

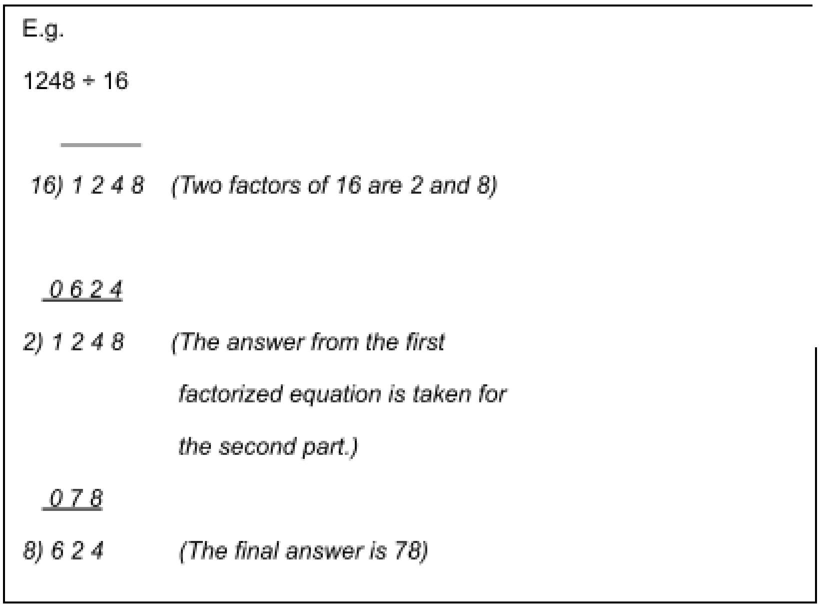
Teachers must ensure that when using this method their understanding is clear of how pupils must lay out their work. Though occasional, miscalculations are inevitable but they can often be avoided with neatly structured recording. This leads to a better understanding of how to work out problems as challenges become more difficult.

Stage 3: Short division of HTU ÷ U	**Stage 4: Long division (as an extension of short division)**
For 291 ÷ 3, because 3 × 90 = 270 and 3 × 100 = 300, we use 270 and split the dividend of 291 into 270 + 21. Each part is then divided by 3. $\begin{array}{r} \underline{9\;7} \\ 3\,)\,2\,{}^{2}9\,{}^{2}1 \end{array}$ The carry digit '2' represents the 2 tens that have been exchanged for 20 units. In the first recording above it is written in front of the 1 to show that a total of 21 ones are to be divided by 3. The 97 written above the line represents the answer: 90 + 7, or 9 tens and 7 units. As clearly cited within the numeracy policy and calculation policy, constant reference to the place value (HTU etc.) when using the above four methods is vital (in particular for pupils in Year 3 and 4). Though the division methods do not use a column as per the other	Example: How many packs of 24 can we make from 560 biscuits? A question like this would always prompt the teacher to ask pupils what they already know. In many cases this would refer to pupils thinking ahead of the calculation and using their multiplication knowledge to get an idea of the possible answer. When laying out their work pupils would use a similar method to the short division layout. i.e. $\begin{array}{r} \underline{2\;3}\ r\,8 \\ 24)\;5\;6\;0 \end{array}$ Along with this method would be the relevant calculation needed. These would include the multiplication of 24 to work out the maximum times it can go into 56 (first division step) and 80 (second division step) and the necessary subtraction to work out the remainder (80 - 72 = 8).

operations, the use of place value can still be applied.

Stage 5b: Factorizing Method of division

Within this method of division the aim is to take long division and make it shorter. This can take place by finding the factors of the divisor so that instead of one big equation, two short division equations take place.



E.g.

1248 ÷ 16

16) 1 2 4 8 *(Two factors of 16 are 2 and 8)*

0 6 2 4

2) 1 2 4 8 *(The answer from the first factorized equation is taken for the second part.)*

0 7 8

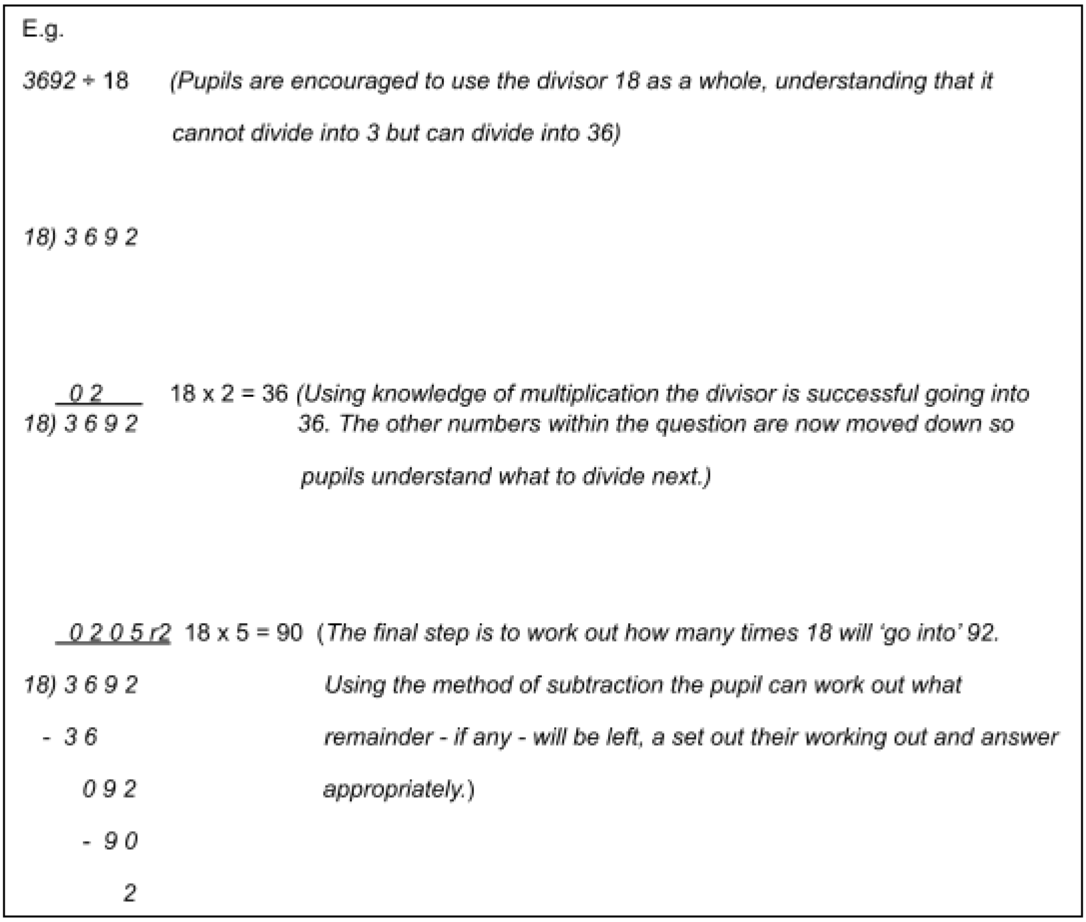
8) 6 2 4 *(The final answer is 78)*

NB: This method will not work if the number that is dividing is prime.

The method itself is made easier when pupils find a smaller factor (i.e. 2 and 8). However, pupils with strong number bonds and times table knowledge will demonstrate an understanding which could use much higher factors.Pupils are also scaffolded to the fact that this method, though convenient, cannot take place if you are dividing by a prime number.

Stage 5c: Formal long division

As set out in the new National Curriculum, it is imperative that pupils understand this form of long division as the formal method and choice when sitting an arithmetic paper. This method enables pupils to use their multiplication skills to answer the division question.



E.g.

3692 ÷ 18 *(Pupils are encouraged to use the divisor 18 as a whole, understanding that it cannot divide into 3 but can divide into 36)*

18) 3 6 9 2

0 2
18) 3 6 9 2 18 x 2 = 36 *(Using knowledge of multiplication the divisor is successful going into 36. The other numbers within the question are now moved down so pupils understand what to divide next.)*

0 2 0 5 r2 18 x 5 = 90 (*The final step is to work out how many times 18 will 'go into' 92. Using the method of subtraction the pupil can work out what remainder - if any - will be left, a set out their working out and answer appropriately.*)

18) 3 6 9 2
- 3 6
0 9 2
- 9 0
2

A pivotal note to make is that understanding and reasoning play a huge role in how pupils are taught the four operations. At Hillborough Junior School questions related toward the understanding and reasoning aspect of learning are in place. These can be heard in lessons verbally through teacher assessment, in feedback through marking and in any formal and informal testing.