Thorpe Hesley Primary School

Calculation Policy for Mathematics

About the calculation policy

The following calculation policy has been devised to meet requirements of the National Curriculum 2014 for the teaching and learning of mathematics, and is also designed to give pupils a **consistent** and **smooth** progression of learning in calculations across the **whole school** from Foundation stage to year 6. There is deliberately no age/year group related advice as teachers should use their own professional judgement as to when it is appropriate to move on to a new method.

It is very important that children have ***mastered*** a stage that they are currently working on before moving onto the next level of development.

Throughout the teaching at Thorpe Hesley Primary School the following principles should be taken into account when teaching calculations. This is to ensure that **conceptual understanding** is embedded simultaneously when working through the written calculation skills.

Concrete Representation

(Students are first introduced to a skill or concept by using objects, preferably real in the context of a problem)

→

Pictorial Representation

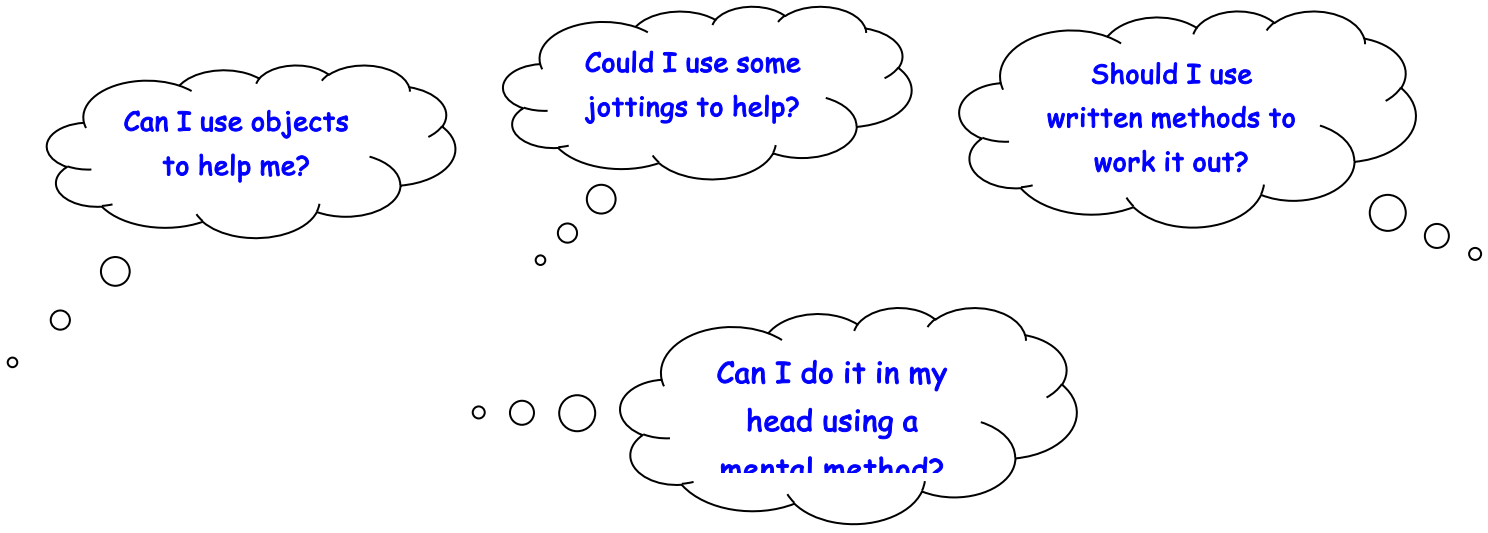
(Student has sufficiently understood the hands on approach and can now relate them to representations such as pictures or diagrams)

→

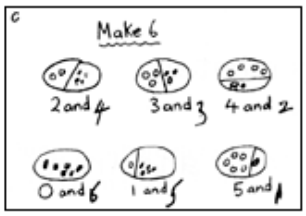
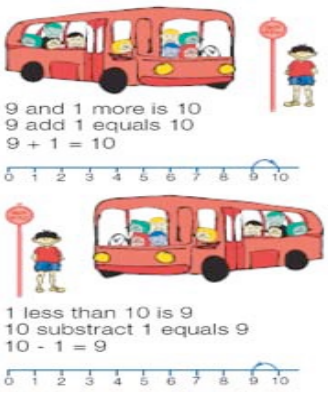
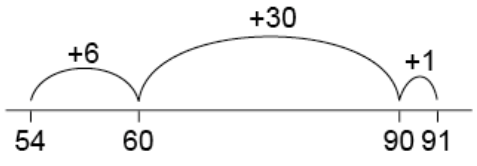
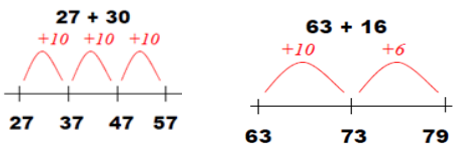
Symbolic Representation

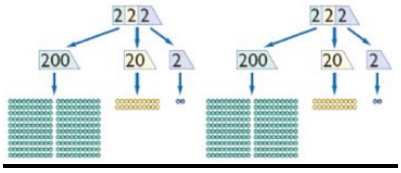
(Student is now capable of representing problems by using mathematical notation)

Children should be taught and encouraged to use the following thought processes in deciding what approach they will take to a calculation, to ensure they select the most appropriate and efficient method for the numbers involved.

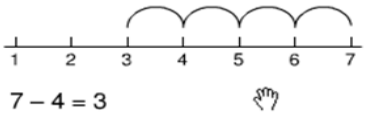
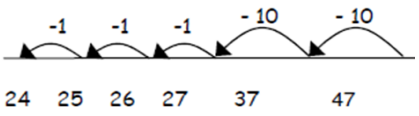
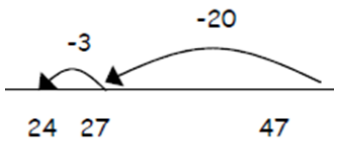
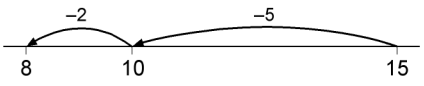


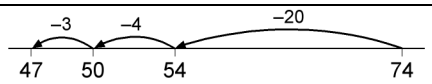
Addition

Stage	Written calculation
Stage 1 <u>Combining two or more sets</u> Children to be shown addition as the combining of 2 or more quantities. Introduce to commutativity. **Key vocabulary.** *add, more, plus, and, make, altogether, total.*	 
Stage 2 **<u>Number line introduction</u>** Record addition by showing jumps on prepared number lines or moving onto higher numbers with the hundred square: and using the addition (+) and equals (=) signs. Recap the law of commutativity. **Key vocabulary** Add, count on, more, plus, make, total, altogether, how many more make….?How many more is …then…? How much more is…then…? Increase	 
Stage 3 **<u>Number line progression</u>** Use a number line. Start with the larger number. Use the tens barrier to bridge through and count on. Recap the law of commutativity. **Key vocabulary** As before, & *sum, tens, ones, partition, addition, column ,tens boundary*	  Using partitioning of numbers then recombine so

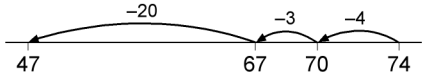
	200 +200 = 400 20 + 20 = 40 2+2 = 4 Altogether is 444 
Stage 4 <u>Expanded column addition</u> Lead to expanded column method, only introducing examples that cross tens boundary when ready. Partitioning both numbers into tens and ones mirrors the column method where ones are placed under ones and tens under tens etc. The black example clearly shows the element of exchange. This also links to mental methods and prepares them for full column addition.	20 + 3 30 + 4 _____ 50 + 7 = 57 or 300 + 40 + 5 200 + 80 + 2 500 + 120 + 7 = 627 36 +48 14 70 84
Stage 5 <u>Column addition</u> In this method, recording is reduced further. Carry digits are recorded below the line, using the words 'carry ten' or 'carry one hundred', not 'carry one'. Later, extend to adding three two-digit numbers, two three-digit numbers and numbers with different numbers of digits. Children may be taught to write the headings (for example) Th H T U when starting with this method but do not need to do it when they are confident with the value of each column.	47 + 76 123 11 258 + 87 345 11 366 +458 824 11
Stage 6 <u>Coloumn addition including decimals</u> Column addition remains efficient when used with larger whole numbers and decimals. Once learned, the method is quick and reliable.	47.04 73.15 + 120.19 1

Subtraction

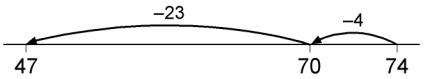
Stage 1	Written calculation
Stage 1 **<u>Take away and see what is left</u>** Record simple subtractions using pictures / marks: Understand subtraction as take away. Key vocabulary. *take, take away, less, leaves, most, least, count back , how many left,*	 8 sheep, he lost 5 he has 3 left
Stage 2 **<u>Number line introduction</u>** **Count back** in ones on a numbered number line to take away: Key vocabulary. *equal to, take, take away, less, minus, subtract, leaves, distance between, how many more, how many fewer / less than, most, least, count back , how many left, how much less is_?*	 7 – 4 = 3 -1 -1 -1 -1
Stage 3 **<u>Number line progression</u>** Subtract by counting back, gradually using more efficient jumps: **Key vocabulary** As before, & *difference, count on, strategy, partition, tens, units* The empty number line helps to record or explain the steps in mental subtraction. A calculation like 74 – 27 can be recorded by counting back 27 from 74 to reach 47. The empty number line is also a useful way of modelling processes such as bridging through a multiple of ten. The steps can also be recorded by counting up from the smaller to the larger number to find the difference, for example by counting up from 27 to 74 in steps totalling 47. With practice, children will need to record less information and decide whether to count back or forward. It is useful to ask children whether counting up or back is the more efficient for calculations such as 57 – 12, 86 – 77 or 43 – 28.	  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:

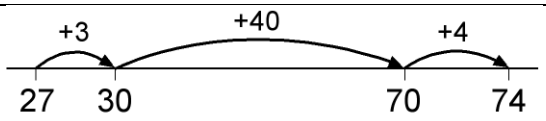


or combined:

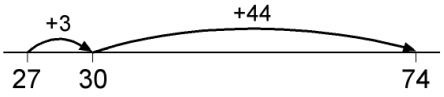


Stage 4

The mental method of counting up from the smaller to the larger number can be recorded using either number lines or vertically in columns. The number of rows (or steps) can be reduced by combining steps. With two-digit numbers, this requires children to be able to work out the answer to a calculation such as 30 + □ = 74 mentally.



or



Stage 5

<u>Partitioning</u>

Subtraction can be recorded using partitioning to write equivalent calculations that can be carried out mentally. For
74 – 27 this involves partitioning the 27 into 20 and 7, and then subtracting from 74 the 20 and the 4 in turn. Some children may need to partition the 74 into 70 + 4 or 60 + 14 to help them carry out the subtraction.

Subtraction can be recorded using partitioning:

74 – 27 =

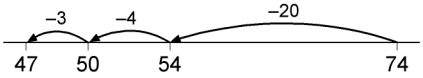
74 – 20 – 7 = 54 – 7 = 47

or

74 – 27 =

70 + 4 – 20 – 7 = 60 + 14 – 20 – 7 = 40 + 7

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 6

<u>Expanded method into column</u>

Partitioning the numbers into tens and ones and writing one under the other mirrors the column method, where ones are placed under ones and tens under tens.

This does not link directly to mental methods of counting back or up but parallels the partitioning method for addition. It also relies on secure mental skills.

The expanded method leads children to the more compact method so that they understand its structure and efficiency. The amount of time that should be spent teaching and practising the expanded method will depend on how secure the children are in their recall of number facts and with partitioning.

Partitioned numbers are then written under one another

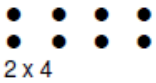
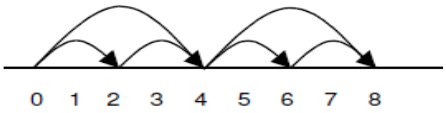
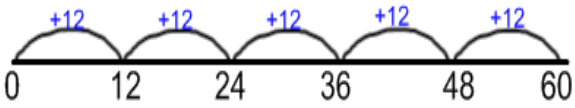
Example: **741 − 367**

$$\begin{array}{r} 700 + 40 + 1 \\ -\ 300 + 60 + 7 \\ \hline \end{array}$$

$$\begin{array}{r} {}^{600}\cancel{700} + {}^{130}\cancel{40} + {}^{11}\cancel{1} \\ -\ 300 + 60 + 7 \\ \hline 300 + 70 + 4 \end{array}$$

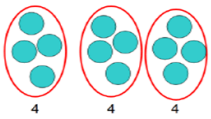
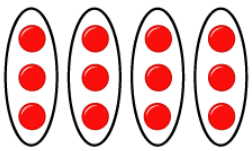
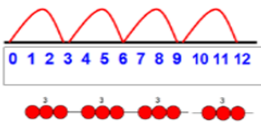
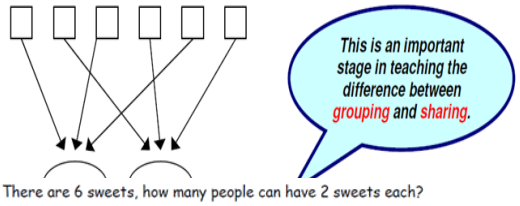
$$\begin{array}{r} {}^{6}\cancel{7}\ {}^{13}\cancel{4}\ {}^{11}\cancel{1} \\ -\ 3\ 6\ 7 \\ \hline 3\ 7\ 4 \end{array}$$

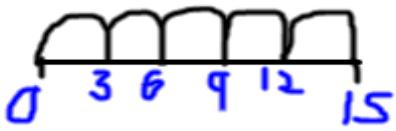
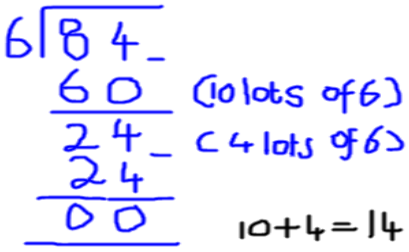
Multiplication

Stage	Written calculation
Stage 1 arrays and jottings Represent multiplication as repeated addition and arrays: **Key vocabulary:** As before, & *multiplied by, column, row, repeated addition, commutative, sets of, equal groups, _ times as big as, once, twice, three times etc.* **Stage 2** repeated addition	2 x 4 = 4 + 4 = 8 2 lots of 4 = 8 2 + 2 + 2 + 2 = 8  2 x 4 This can be modelled on a number line:   **4 x 5 = 20** **5 x 12 = 5 lots of 12.** 
Stage 3 Grid method As a staging post, an expanded method which uses a grid can be used. This is based on the distributive law and links directly to the mental method. It is an alternative way of recording the same steps. It is better to place the number with the most digits in the left-hand column of the grid so that it is easier to add the partial products. This method may be chosen to develop in the following way: 1 digit multiplied by 2 digit 1 digit multiplied by 3 digit 2 digit multiplied by 2 digit 2 digit multiplied by 3 digit Decimals multiplied by 1 digit/2 digit/3 digit etc	**6 x 124 =** |	**100**	**20**	**4**
---	---	---	---
6	**600**	**120**	**24**	 600 120 024+ 744

Stage 4 Mental multiplication using partitioning Mental methods for multiplying TU × U can be based on the distributive law of multiplication over addition. This allows the tens and ones to be multiplied separately to form partial products. These are then added to find the total product. Either the tens or the ones can be multiplied first but it is more common to start with the tens. NB: Stages 3 and 4 support each other and can be taught in either order however, stage 4 is the most time-efficient method.	**4 3 x 6 =** 40 x 6 = 2 4 0 3 x 6 = 1 8 240 + 18 = 258
Stage 5 Expanded short multiplication The n ext step is to represent the method of recording in a column format, but showing the working. Draw attention to the links with the grid method above. Children should describe what they do by referring to the actual values of the digits in the columns. For example, the first step in 38 × 7 is 'thirty multiplied by seven', not 'three times seven', although the relationship 3 × 7 should be stressed. Most children should be able to use this expanded method for TU × U by the end of Year 4.	$30+8$ $\times\ 7$ 210 56 266 $30\times7=210$ $8\times7=56$ 38 $\times\ 7$ 210 56 266
Stage 6 Short multiplication The recording is reduced further, with carry digits recorded below the line. If, after practice, children cannot use the compact method without making errors, they should return to the previous method.	38 $\times\ 7$ 266 5

Division

Stage	Written calculation
Stage 1 <u>Group and share small quantities</u> Using objects, diagrams and pictorial representations to solve problems about **both grouping and sharing**. **Key Vocabulary** *share, share equally, one each, two each…, group, groups of, lots of, array* This may include calculations that have remainders.	12 children need to get into teams of 4 to play a game. How many teams are there?    6 sweets are shared between 2 people. How many do they have each? 
Stage 2 <u>Group and share, using the ÷ sign</u> Use objects, arrays, diagrams and pictorial representations, and **repeated addition on a number line.** **Key vocabulary** As before, & *divide, divided by, divided into, division, grouping, number line, left, left over* This may include calculations that have remainders.	  12 ÷ 3 = 4 **12 ÷ 3 = 4** 6 sweets shared between 2 people, how many do they each get?  There are 6 sweets, how many people can have 2 sweets each? 

Stage 3 Division as repeated subtraction on a number line Children should also be able to see the pattern in division by posing the questions "How many lots of ……. in ……?" This may be shown through repeated subtraction on a number line, by 'taking away lots' or through mental methods and 'counting on'. This may include calculations that have remainders	 
Stage 4 Chunking Chunking is done by using multiples of the number that the total has to be divided by (the divisor) to break the sum down into sizeable chunks that are subtracted from the total. It relies on children being confident with most times tables and the column-method for subtraction; if they are not- this method should not be attempted. It clearly shows the progression in steps and aids children in their understanding of place value. This may include calculations that have remainders	
Stage 5 Short division Children who have a secure knowledge of multiplication facts and place value should be able to move on quickly to the more efficient recording on the right.	**81÷3 =** $3\overline{)8^{2}1}$ r 0 → 27 **291 ÷ 3 =** $3\overline{)2\,9^{2}1}$ r 0 → 97