Calculation Policy

(with guidance)

2014-15

The following document is intended to prescribe the pathway for development of **written** calculation throughout Meltham CE Junior School – it may at times however, cross into the use of mental calculation

Teachers may revert to methods used in previous years in order to provide for learners who are not progressing in line with their contemporaries, but progress forward into calculation strategies intended for subsequent years is not permitted without discussion with the Maths Coordinator or a member of Senior Leadership.

Whole class teaching must always follow the written calculation policy for any given year group.

This document is intended to give our learners the maximum possible exposure to each step along the pathway in order that standards will improve in the long-term.

The complexity of a problem is determined by the problem itself, not by the written strategy that culminates in its resolution. As teachers, we can extend our children's learning and accelerate their progress whilst at the same time entrenching the written calculation methods.

Display of Written Calculation methods in all four operations.

Each classroom should display the written calculation strategy for that year as part of the permanent display. The following colour coordination should be adhered to in order to provide consistency across school:

Multiplication displayed on a RED background

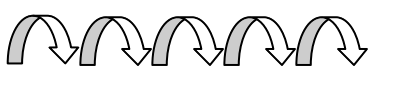
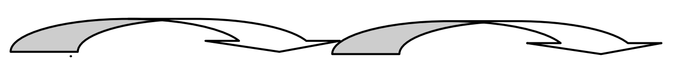
Division displayed on a GREEN background

Addition displayed on a YELLOW background

Subtraction displayed on a BLUE background

Exemplar progression in the written calculation of **ADDITION**

Year	Calculation method and examples	Guidance
R – 1	Counting on using song, visual aids, dominoes, counters, number lines and 100 squares, finger counting. Images and models and a pictorial representation of the mechanics of addition. **Drawing** of pictures or objects accompanied by recording pictorially: Teacher**:** I buy 3 balls and my friend gives me two more! Now how many do I have altogether? This may simultaneously be recorded as 3 + 2 = 5 as the language of addition is introduced.  Children should also use **marks or pictures on paper** or on white boards as a calculation strategy. Teacher**:** If 6 people are in the role play area and 5 more want to join their game, how many will be there altogether?  This may simultaneously be recorded as 6 + 5 as the language of addition is introduced. **There are myriad other methods to display working – recorded and supported – this document is not intended to make them obsolete.**	Use of jottings and marks – diagrams and pictures – to solve problems; moving then to the use of number lines. Encourage children to put the larger number first. Know that addition can be done in any order.

1 - 2	**Partitioning using jottings** **Use of vertical or horizontal layout to set out mental problems** – working out should **not** be encouraged by mentally adding each line; concretes (beads, blocks, Numicon, Diennes, number lines) should be the tools used to find the answer. $\begin{array}{r} 4 \\ +\ 3 \\ \hline \end{array}$ $\begin{array}{r} 3 \\ 7 \\ +\ 4 \\ \hline \end{array}$ $\begin{array}{r} 10 \\ 5 \\ +\ 2 \\ \hline \end{array}$ 4 + 3 = 7 + 3 + 4 = 10 + 5 + 2 = **Use of the number line and apparatus (concretes)** - for example, bridging through 10. $\square$ = 6 + 5 becomes 11 = 6 + 5 +1 +1 +1 +1 +1  6 11 27 + 8 = 35 +3 +5  27 30 35 **CHILDREN'S STEPS WILL OFTEN BE INDIVIDUAL TO THEIR OWN LEVEL OF DEVELOPMENT –** THEIR STEPS MAY BE IN ONES FROM 27 TO 45.	The children should use these two methods only until year 3 and **CONCRETES, models and images SHOULD ALWAYS BE USED** TO SUPPORT THIS - THERE SHOULD BE NO MOVE TO ABSTRACT YET. This will continually reinforce place value and also entrench the methods, creating a fall-back strategy for test situations and for dealing with two-part problems in which the addition may not be the main focus of teaching and learning In addition to these primary methods, others may be delivered as part the new National Curriculum when considering mental calculation or use of known facts. However, these methods should be revisited time and time again. When asked, "How do we calculate the following addition problem?" children should automatically be able to respond in either or both of the two written calculation methods for years R-3
3 & 4	USE OF THE NUMBER LINE **WILL** CONTINUE THROUGHOUGHT YEAR 3 & 4 AS PART OF THE DEVELOPMENT OF A RAFT OF STRATEGIES CHILDREN CAN USE **Introduction of vertical layout using partitioning, with the support of concretes (Diennes blocks) and possible ICT representation, will map each step of the instruction of this new method.**	Concretes should be used at all new introductory stages

378 + 487

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

Leading firstly to 3-digit calculation:

378 + 387 (without the need to carry and using the **MOST** significant digit first)

$$\begin{array}{r}378\\ +\ 487\\ \hline 700\\ 150\\ 15\\ \hline 865\end{array}$$

Vertical layout, expanded working, adding the least significant digit first (supported with concretes) and without the need to carry

$$\begin{array}{r}43\\ +\ 56\\ \hline 9\\ 90\\ \hline 99\end{array} \qquad \begin{array}{r}368\\ +\ 431\\ \hline 9\\ 90\\ 700\\ \hline 799\end{array}$$

Leading to Vertical layout crossing the tens barrier

$$\begin{array}{r}17\\ +\ 35\\ \hline 12\\ 40\\ \hline 52\end{array} \qquad \begin{array}{r}255\\ +\ 164\\ \hline 9\\ 110\\ 300\\ \hline 419\end{array} \qquad \begin{array}{r}134\\ +\ 87\\ \hline 11\\ 110\\ 100\\ \hline 221\end{array} \qquad \begin{array}{r}134\\ 253\\ +\ 33\\ \hline 10\\ 110\\ 300\\ \hline 420\end{array}$$

It is crucial to consistently reiterate the partitioning and place value and resist the urge to move on.

The complexity of mathematical investigation can be deepened and extended without the need to instruct in a new strategy.

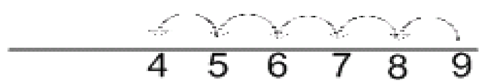
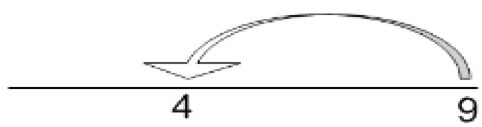
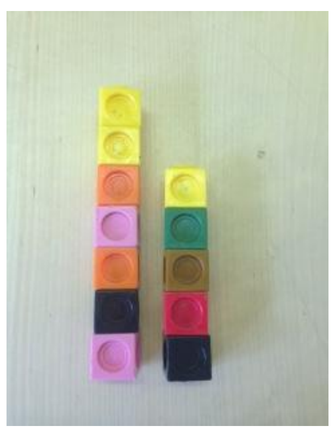
When discussing adding the numbers in the tens or hundreds column, the value should be used i.e. Ten and fifty not 1 and 5 in the adjacent example.

Likewise, when adding within the hundred column, 1 hundred and 7 hundred, not 1 and 7.

5	**Vertical layout, expanded working, adding the least significant digit first** 1225 + 4769 14 80 900 5000 5994 35.4 + 28.8 1.2 13 50 64.5 **Vertical layout, contracting the working to a compact efficient form, moving from the least significant digit first:** 47 + 76 13 110 123 47 + 76 123 1 1	Building on Year 4 but increasing the difficulty using 3-digit numbers, decimal numbers, numbers with 0 holding a place, mixing 2 and 3-digit numbers and decimal and none-decimal numbers. **Teacher judgement will inform the decision to move to the compact standard form of addition in preparation for Year 6.** **Concretes used to support this** Progress from 2 to 3-digit.
6	**The standard written method should be used in Year 6 although strong classroom practice will revert to strategies used in former years if a child is experiencing difficulty.** Complexity should increase (2 decimal places as well as incorporating tens and hundreds of thousands, as well as using the strategy in problem solving) As before, when modelling, the value of each number must be discussed:	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. The use of estimation and rounding is important as many children do not see the

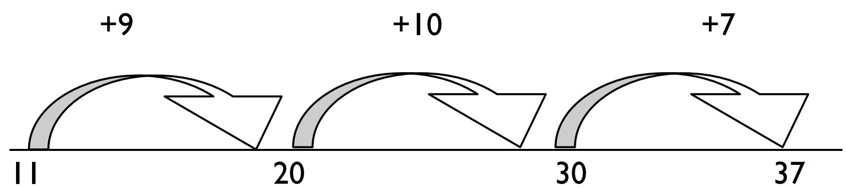
	124.6 + 95.3 ——— 219.9 ——— 1 **"Children, what is 0.6 added to 0.3? What is 5 and 4? What is the sum of 90 and 20? Where should we carry our one hundred?"**	improbability of their answer. It is often simply accepted.

Exemplar progression in the written calculation of **Subtraction**

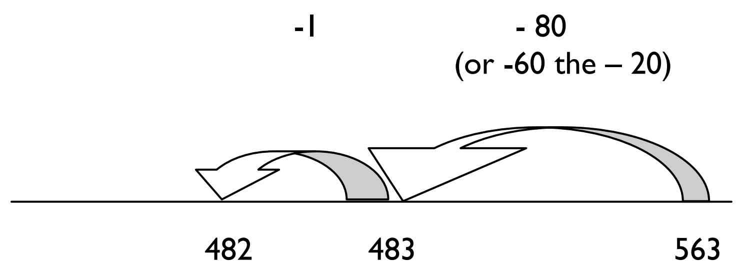
Year	Calculation method and examples	Guidance
R – 1	Pictorial representation of the mechanics of subtraction as taking away and of finding the difference by comparing, followed by counting back using number lines, 100 squares or mentally. The relationship between taking away and finding the difference should be recognised as important. 9 – 5 = **4** Or 7 – 5 = **2**    **Working towards using…**	Concretes Pictures Jottings Number lines Physically jumping Solve problems Lots of practise with manipulatives taking away and looking at the difference between amounts Children should spend time physically DOING subtraction – jumping backwards and forwards in hoops/on giant number lines or squares and LOOKING at difference between amounts in towers, piles, sets etc
Y2	**Number line method** 37 - 11 = **26** -1 -10 Imagine 2 arrows here counting back! 26 27 37	Children should spend time examining number lines. Choose 2 random numbers – is it easier to count forwards or backwards? A mixture of counting backwards and counting on from the lowest to the highest in conjunction with the learning that

Y3

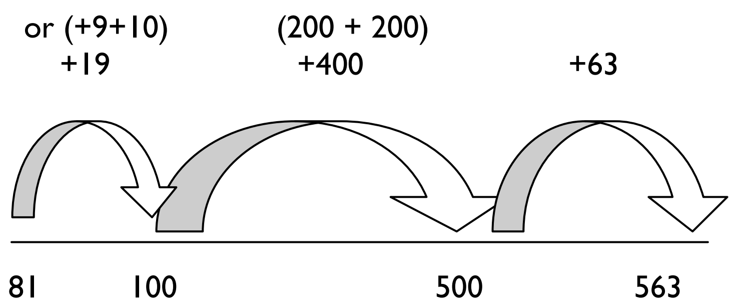
Or counting up



563 - 81 = **482**



Or



facilitates an understanding of subtraction as the inverse of addition

The complexity and size of children's steps, whether forward or backwards, along the blank number line should be individual and all levels of ability should be reflected in teachers' modelling.
All teaching should be supported by Diennes, Numicon, pictorials etc…
Recording should be done horizontally, vertically, with missing numbers, reversals

Children will start with:
3 digit – 1 digit
3 digit – 2 digit
3 digit – 3 digit (as example)

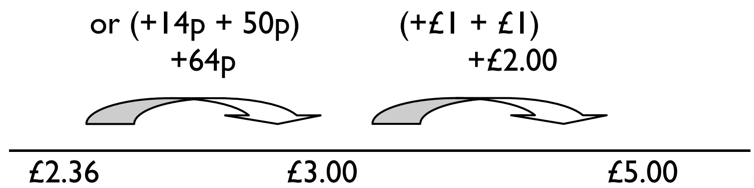
The complexity and size of children's steps, whether forward or backwards, along the blank number line should be individual and all levels of ability reflected in teacher modelling.

Y4

In Years 4 and 5 the strategy should continue to be used and be expanded for use when applying maths to time (hours and minutes) and money (pounds and pence with decimal point) problems.

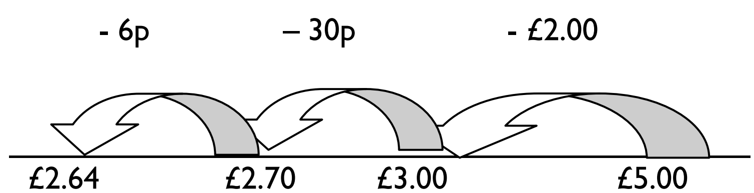
Money

£5 - £2.36 = **£2.64**



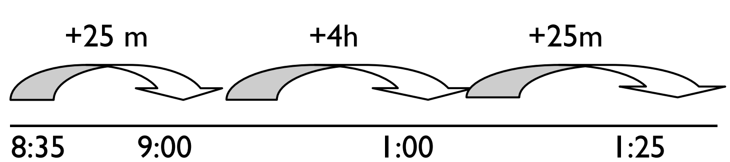
Or

£5 - £2.36 = **£2.64**



Time

8:35 to 1:25

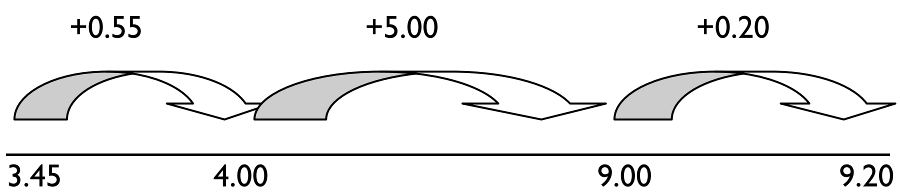


Answer: 4h 50m

Y5-6

In Year 5/6, although vertical subtraction may be taking place, the use of the number line could be employed to teach finding the difference between numbers including 2 decimal places. It is also a useful tool when continuing calculating time problems:

9.2 - 3.45 = **5.75**



Columnar Subtraction

This method of written calculation **Will not** be taught before Summer 2 in Year 3 alongside the number line method

3 (END OF)

Children should only be instructed in the first stage of vertical subtraction during Summer Term 2. If children are considered by their teacher not to be ready, then it should be omitted and it is advised that instruction take place during guided groups.

56 – 23 = **33**

	50	6		
-	20	3		
	30	3	=	**33**

MUST USE MANIPULATIVES FIRST
Questions recorded horizontally and vertically

IN SUMMER 2 ONLY

STEP ONE OF THE DECOMPOSITION PATHWAY ONLY (2-DIGIT NUMBERS AND NO EXCHANGING)

4

The total strategy of decomposition will be taught in Year 4 and 5 following the following pathway and recapping on the work undertaken by *some* pupils during Summer Term 2 in Year 3:

56 – 23 = **33**

	50	6		
-	20	3		
	30	3	=	**33**

Differentiate with:

563 - 241 = **322**

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

Leading to:

593 - 277 = **316**

	500	90	3
-	200	70	7

500	80	13		
200	70	7		
300	10	6	=	**316**

The top line is re-arranged. This should be explained clearly with the correct terminology being used and when discussing the subtraction during whole class (or Guided Maths Group) modelling, the value of each number should be dealt with (i.e. sixty subtract forty).

INTRODUCE EXCHANGING (borrowing) USING MANIPULATIVES FIRST. LET CHILDREN INVESTIGATE FOR THEMSELVES. Begin with only 1 digit to exchange.

Discussion and modelling would be the same as it always has been, but this visual representation of exchanging **MUST** precede the standard written method.

<table>
<tr>
<td>Y5</td>
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Leading to:

473 - 385 = 88

$$\begin{array}{lccc} & 400 & 70 & 3 \\ - & 300 & 80 & 5 \\ \hline \end{array} \Rightarrow \begin{array}{ccccc} 300 & 160 & 13 & & \\ 300 & 80 & 5 & & \\ \hline 0 & 80 & 8 & = & \mathbf{88} \end{array}$$

Leading finally to:

563 - 278

$$\begin{array}{lccc} & {}^{4}\cancel{5} & {}^{15}\cancel{6} & {}^{1}3 \\ - & 2 & 7 & 8 \\ \hline & 2 & 8 & 5 \end{array}$$
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<td>
Begin the process of EXCHANGING with the units column

Lead into 4-digit numbers by the close of Year 5
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<tr>
<td>Y6</td>
<td colspan="2">
Reinforcing the method, children should extend into 4 digit numbers and beyond. Use the method as part of the application of maths, and extend by incorporating decimals. In addition, extend into the resolution of money problems using 2 decimal places in tandem with the aforementioned number line.

The use of previous methods should not be ignored to reinforce the learning of children for whom decomposition in subtraction remains problematic.

Strong practice will draw on previous methods when necessary.
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