

Marden Bridge

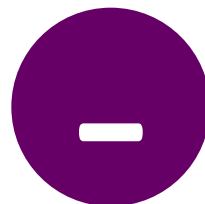


Middle School

*Believe, achieve, succeed*

# Calculation Policy

2023



Through our mathematics curriculum at Marden Bridge Middle School, we have developed a mastery approach to our teaching and learning, ensuring that children develop skills sequentially using a small step, approach and building a depth of understanding for each mathematical skill. Our curriculum aims to support children with 'bridging the gap' between abstract mathematical concepts and concrete representations so that they can manipulate and visually represent their ideas, accessing mathematical learning by problem-solving and the use of rich language.

We aim to encourage a love of mathematics, through designing engaging lessons that are full of practical hands-on activities designed to stimulate and promote reasoning skills and problem-solving. Our lessons involve the use of manipulatives to explore concepts and maths talk to investigate ideas and strategies to support learning. The use of concrete resources further supports children to deepen their understanding of mathematical concepts and make connections that allows them fully comprehend written methods.

In order to develop these skills children must have a firm understanding of written and mental calculations. This documents details the methods we use at Marden Bridge along with key vocabulary that will support children in their journey of mathematics. These methods have been produced in line with the National Curriculum (DfE, 2013). Our calculation policy is displayed in all classrooms across school regardless of curriculum area. Numeracy across the curriculum, is essential in building children's understanding of mathematics using various real life contexts.

Throughout this document the use of key terminology and STEM sentences are clearly signposted. Promoting and using the correct mathematical language is critical to embedding a good mathematical understanding. All new vocabulary is carefully introduced at appropriate times with concrete and pictorial representations to support learning. High expectations of the correct language is expected across the curriculum promoting written explanations and reasoning.

# National Curriculum

## Addition and Subtraction

**Key Stage 2 :** Add and subtract whole numbers with more than 4 digits, including using formal written methods.

Add and subtract numbers mentally. Use rounding to check answers to calculations.

Solve addition and subtraction multi-step problems in contexts, deciding which operation and methods to use and why.

**Key Stage 3 :** Use the four operations, including formal written methods, applied to integers, decimals, and fractions, all both positive and negative.

Recognise and use relationships between operations including inverse operations.

Interpret fractions and percentages as operators.

Use approximation through rounding to estimate answers and calculate possible resulting errors.

## Multiplication and Division

**Key Stage 2 :** Multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers

Multiply and divide numbers mentally drawing upon known facts

Divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately.

Multiply and divide whole numbers and those involving decimals by 10, 100 and 1000

Solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates.

**Key Stage 3 :** Interpret when the structure of a numerical problem requires additive, multiplicative or proportional reasoning.

Understand that a multiplicative relationship between 2 quantities can be expressed as a ratio or a fraction. Use the concepts and vocabulary of prime numbers, factors, multiples, common factors, common multiples, hcf, lcm, prime factorisation, including using product notation and the unique factorisation property.

Divide a given quantity into 2 parts in a given part:part or part:whole ratio; express the division of a quantity into 2 parts as a ratio.

Apply the four operations in algebraic contexts.

# Addition and Subtraction Written Methods

Formal Written Method for addition (expanded)

A handwritten calculation on grid paper showing the addition of 7948 and 4635. The numbers are aligned in columns. A horizontal line is drawn below the second number. Below the line, the values are broken down into their place value components: 13 (8 + 5) for the ones column, 70 (40 + 30) for the tens column, 1,500 (900 + 600) for the hundreds column, and + 11,000 (7000 + 4000) for the thousands column. A final horizontal line is drawn below these components, and the sum 12,583 is written below it.

Introduction to the column method through partitioning. This should be introduced alongside the concrete and pictorial representations. Addition starts from the right hand column ( in this case the ones ).

Formal Written Method for addition

A handwritten calculation on grid paper showing the addition of 7948 and 4635. The numbers are aligned in columns. A horizontal line is drawn below the second number. Below the line, the digits 1, 1, and 1 are written in the hundreds, tens, and ones columns respectively, indicating exchanges. A final horizontal line is drawn below these digits, and the sum 12,583 is written below it.

When setting up the formal written method children should leave a line underneath their calculation. This space should be used to record any exchanges that may take place. Missing a line allows children to clearly record their exchanges to be included in the next step.

Formal Written Method for addition involving decimals

A handwritten calculation on grid paper showing the addition of 153.48 and 297.06. The numbers are aligned in columns, with the decimal points aligned. A horizontal line is drawn below the second number. Below the line, the digits 1, 1, and 1 are written in the hundreds, tens, and ones columns respectively, indicating exchanges. A final horizontal line is drawn below these digits, and the sum 450.54 is written below it.

When using the formal written method to add decimals children should again set out their calculation ensuring they leave a line below to record any exchanges. Note the decimal point does not have its own column.

Formal Written Method for subtraction

A handwritten calculation on grid paper showing the subtraction of 1894 from 2135. The numbers are aligned in columns. A horizontal line is drawn below the second number. Above the line, the digits 1, 4, and 1 are written in the hundreds, tens, and ones columns respectively, indicating regrouping. A final horizontal line is drawn below these digits, and the result 1563 is written below it.

When using the formal written method for subtraction it is important to leave a line above the calculation. This is to allow for any regrouping which may need to take place. Note that this is clearly written above the original number.

# Addition and Subtraction STEM Sentences and Key Vocabulary

Millions			Thousands			Ones		
H	T	O	H	T	O	H	T	O

Exchange				7	3	4	6
	+	4	6	3	5		
						1	
		1	1	9	8	1	

together  
combine  
join  
total  
addition  
how many  
both  
plus  
more  
increase  
altogether  
add  
grow

Addition is commutative.

If the column sum is equal to ten or more, we must exchange.

If we change the order of the addends, the sum remains the same.

If one addend is increased by an amount and the other addend is decreased by the same amount, the sum remains the same.

I have added \_\_\_ to this addend so I must subtract \_\_\_ from the other addend to keep the sum the same.

Millions			Thousands			Ones		
H	T	O	H	T	O	H	T	O

Regroup				2	16	13	12
		<del>3</del>	<del>7</del>	<del>4</del>	<del>2</del>		
	-	1	8	7	3		
		1	8	6	9		

take away  
leave  
remove  
less  
subtract  
difference  
decrease  
change  
remain  
deduct  
left  
minus  
fewer

Subtraction is not commutative

If there is an insufficient number to subtract from in a given column, we must regroup from the column to the left.

The more we subtract, the less we are left with. The less we subtract, the more we are left with.

If the minuend and the subtrahend are changed by the same amount, the difference remains the same.

In a balanced equation, if I add an amount to the minuend or subtrahend, I need to add the same amount to the subtrahend or minuend

# Addition and Subtraction Mental Strategies

At Marden Bridge we routinely focus on using mental strategies to develop a deeper conceptual understanding and a comfortability with number. We use number talks throughout both key stages to help pupils develop their computational fluency and flexible thinking. These strategies provide opportunities to clarify and communicate their own ideas, consider and try other strategies, investigate and apply mathematical connections and relationships. Pupils use these strategies to build a variety of techniques, learning from their mistakes in order to solve problems.

## Addition

Round then adjust

$$\begin{array}{l} 63 + 28 \\ 63 + 30 = 93 \\ 93 - 2 = 91 \end{array}$$

Take and Give

$$\begin{array}{l} 63 + 28 \\ \overset{+2}{\curvearrowright} \\ 61 + 30 = 91 \end{array}$$

Partition

$$\begin{array}{l} 63 + 28 \\ 60 + 20 = 80 \\ 3 + 8 = 11 \\ 80 + 11 = 91 \end{array}$$

Count on

$$\begin{array}{l} 63 + 28 \\ \xrightarrow{+20} 83 \xrightarrow{+7} 90 \xrightarrow{+1} 91 \end{array}$$

Break apart

$$\begin{array}{l} 63 + 28 \\ 63 + 20 = 83 \\ 83 + 8 = 91 \end{array}$$

Near doubles

$$\begin{array}{l} 26 + 27 \\ 2 \times 26 = 52 \\ 52 + 1 = 53 \end{array}$$

## Subtraction

Round to a multiple of ten

$$\begin{array}{l} 63 - 28 \\ 63 - 30 = 33 \\ 33 + 2 = 35 \end{array}$$

Partition

$$\begin{array}{l} 63 - 28 \\ 63 - 20 = 43 \\ 43 - 3 = 40 \\ 40 - 5 = 35 \end{array}$$

Count on

$$\begin{array}{l} 63 - 28 \\ 28 + 2 = 30 \\ 30 + 33 = 63 \\ \text{or} \\ \xrightarrow{+2} \xrightarrow{+33} \\ 28 \quad 63 \end{array}$$

Constant Difference

$$\begin{array}{l} +2 \left( \begin{array}{l} 63 - 28 \\ \phantom{63 - 28} \end{array} \right) +2 \\ 65 - 30 \\ = 35 \end{array}$$

Using negatives

$$\begin{array}{l} 63 - 28 \\ 60 - 20 = 40 \\ 3 - 8 = -5 \\ 40 - 5 = 35 \end{array}$$

# Multiplication and Division

## Written Methods

Formal Written Method for multiplication (expanded)

$$\begin{array}{r}
 \dots \\
 23 \\
 \times 45 \\
 \hline
 15 \quad (3 \times 5) \\
 100 \quad (20 \times 5) \\
 120 \quad (3 \times 40) \\
 + 800 \quad (20 \times 40) \\
 \hline
 1035
 \end{array}$$

Introduced alongside the grid method to aid understanding. Each multiplication calculation is recorded. Multiplication starts from the right hand column ( in this case the ones ).

Formal Written Method for multiplication

$$\begin{array}{r}
 \dots \\
 23 \\
 \times 45 \\
 \hline
 115 \quad (23 \times 5) \\
 + 920 \quad (23 \times 40) \\
 \hline
 1035
 \end{array}$$

Children use the short written method using exchanging with numbers appropriate to their current level of attainment. The digit exchanged goes underneath the answer. This is introduced alongside the grid method which children should be familiar with from year 4.

Formal Written Method for short division

$$\begin{array}{r}
 047.4 \\
 5 \overline{) 22337.20}
 \end{array}$$

Children consolidate their previous learning of the formal method in year 5. Key vocabulary such as divisor, dividend and quotient are introduced.

Formal Written Method for long division

$$\begin{array}{r}
 286 \\
 4 \overline{) 1144} \\
 - 8 \downarrow \\
 \hline
 34 \\
 - 32 \downarrow \\
 \hline
 24 \\
 - 24 \\
 \hline
 0
 \end{array}$$

Children are introduced to the formal written method for long division in year 6. The children are supported in this method by DMSB ( Divide, Multiply, Subtract, Bring down ).

# Multiplication and Division

## STEM Sentences and Key Vocabulary

Millions			Thousands			Ones		
H	T	O	H	T	O	H	T	O

Exchange

			H	T	O			
			4	3				
			x	5	4			
				1	7	2		(43 x 4)
				2	1	5	0	(43 x 50)
					2	3	2	

double  
lots of groups of  
array multiple  
product per  
repeated addition times  
multiply by equal groups

Multiplication is commutative.

Factor times factor is equal to the product

To multiply two two-digit numbers, first multiply by the ones, then multiply by the tens, then add them together.

To multiply a three-digit number by a two-digit number, first multiply by the ones, then multiply by the tens, then add them together.

Millions			Thousands			Ones		
H	T	O	H	T	O	H	T	O

			2	4	6	4		
				13	19	12		
			3	7	3	9	2	
				2	4	6	4	
			3	7	3	9	2	

Regroup

ratio  
division out of  
share  
quotient divided by  
separate each  
average

Division is not commutative.

Dividend divided by divisor is equal to the quotient.

If there is an insufficient number to subtract from in a given column, we must regroup from the column to the left.

If the dividend is a multiple of the divisor there is no remainder. If the dividend is not a multiple of the divisor. There is a remainder.

The remainder is always less than the divisor.



# Multiplication and Division Mental Strategies

At Marden Bridge we routinely focus on using mental strategies to develop a deeper conceptual understanding and a comfortability with number. We use number talks throughout both key stages to help pupils develop their computational fluency and flexible thinking. These strategies provide opportunities to clarify and communicate their own ideas, consider and try other strategies, investigate and apply mathematical connections and relationships. Pupils use these strategies to build a variety of techniques, learning from their mistakes in order to solve problems.

## Multiplication

### Break a factor

Handwritten notes on grid paper showing the strategy 'Break a factor'. It starts with  $12 \times 16$ . The student breaks 16 into 10 and 6, so  $12 \times 16 = 12 \times (10 + 6)$ . They then calculate  $10 \times 12 = 120$  and  $6 \times 12 = 72$ , and finally add them to get 192.

$$\begin{array}{r} 12 \times 16 \\ 12 \times 16 = 12 \times (10 + 6) \\ = (10 + 6) \times 12 \\ 10 \times 12 = 120 \\ 6 \times 12 = 72 \\ \hline 192 \end{array}$$

### Halving and Doubling

Handwritten notes on grid paper showing the strategy 'Halving and Doubling'. It starts with  $12 \times 16$ . The student halves 12 to 6 and doubles 16 to 32, then halves 32 to 16, resulting in  $6 \times 16 = 96$ . Finally, they double 96 to get 192.

$$\begin{array}{r} 12 \times 16 \\ 12 \times 16 = 24 \times 8 \\ = 48 \times 4 \\ = 96 \times 2 \\ = 192 \end{array}$$

### Round and Adjust

Handwritten notes on grid paper showing the strategy 'Round and Adjust'. It starts with  $12 \times 16$ . The student rounds 16 up to 20, calculates  $12 \times 20 = 240$ , then rounds 16 down to 4, calculates  $12 \times 4 = 48$ , and adjusts:  $240 - 40 = 200$  and  $200 - 8 = 192$ . A note in a cloud says  $16 = 20 - 4$ . A small diagram shows  $48 < \begin{matrix} 40 \\ 8 \end{matrix}$ .

$$\begin{array}{r} 12 \times 16 \\ 12 \times 20 = 240 \\ 12 \times 4 = 48 \\ 240 - 40 = 200 \\ 200 - 8 = 192 \end{array}$$

### Factor a Factor

Handwritten notes on grid paper showing the strategy 'Factor a Factor'. It starts with  $12 \times 16$ . The student factors 12 as  $4 \times 3$  and 16 as  $4 \times 2 \times 2$ , so  $12 \times 16 = 12 \times (4 \times 2 \times 2)$ . They then calculate  $12 \times 4 = 48$ ,  $48 \times 2 = 96$ , and  $96 \times 2 = 192$ .

$$\begin{array}{r} 12 \times 16 \\ 12 \times 16 = 12 \times (4 \times 2 \times 2) \\ 12 \times 4 = 48 \\ 48 \times 2 = 96 \\ 96 \times 2 = 192 \end{array}$$

## Division

### Multiply instead

Handwritten notes on grid paper showing the strategy 'Multiply instead'. It starts with  $17 \div 3$ . The student says 'I know...' and explains:  $3 \times 5 = 15$ , so I have 5 groups of 3, then I have 2 left, so 5 remainder 2.

$$17 \div 3$$

I know...

$3 \times 5 = 15$ , so I have 5 groups of 3, then I have 2 left  
5 remainder 2

### Chunking

Handwritten notes on grid paper showing the strategy 'Chunking'. It starts with  $643 \div 30$ . The student uses a long division style, subtracting  $30 \times 20 = 600$  and  $30 \times 1 = 30$  from 643 to get a remainder of 13. The final answer is 21 remainder 13.

$$\begin{array}{r} 30 \overline{)643} \\ - 600 \quad (20 \times 30 = 600) \\ \hline 43 \\ - 30 \quad (1 \times 30 = 30) \\ \hline 13 \end{array}$$

21 remainder 13

### Using Factors

Handwritten notes on grid paper showing the strategy 'Using Factors'. It starts with  $864 \div 36 =$ . The student breaks 36 into  $4 \times 9$ , then divides  $864 \div 4 = 216$  and  $216 \div 9 = 24$ . The final answer is 24.

$$864 \div 36 =$$

$36 = 4 \times 9$   
 $864 \div 4 = 216$   
 $216 \div 9 = 24$

24

### Half and then Half

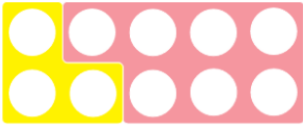
Handwritten notes on grid paper showing the strategy 'Half and then Half'. It starts with  $128 \div 8$ . The student halves 128 to 64, then halves 64 to 32, and finally halves 32 to 16. The final answer is 16.

$$\begin{array}{r} 128 \div 8 \\ 64 \div 4 \\ 32 \div 2 = 16 \end{array}$$

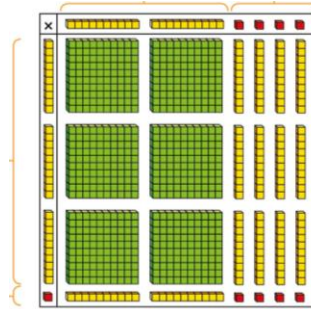
16

# Representations

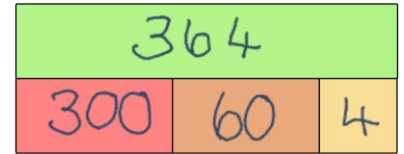
Using both physical manipulatives and ICT we allow children to explore new concepts. Manipulatives can be a great way of supporting your children to develop and deepen their understanding of new concepts. It can also aid them in solving tricky problems.



numicon



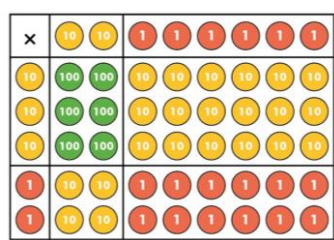
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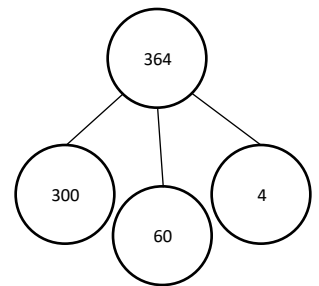
bar model



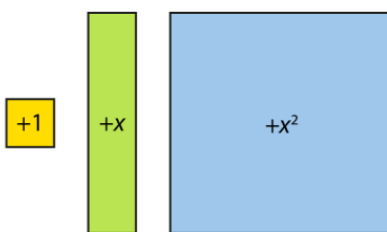
tens frames



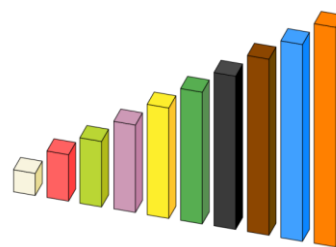
place value counters



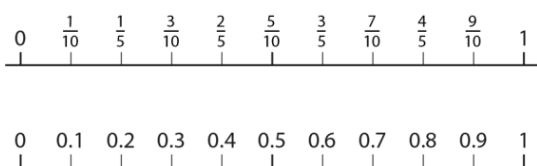
part whole model



algebra tiles



cuisineaire



number lines

1000	2000	3000	4000	5000	6000	7000	8000	9000
100	200	300	400	500	600	700	800	900
10	20	30	40	50	60	70	80	90
1	2	3	4	5	6	7	8	9

gattegno chart