St Michael's Catholic Primary School

Calculation Policy

Addition and Subtraction

Intent

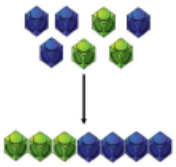
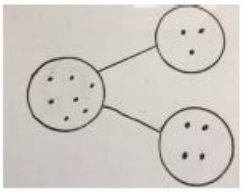
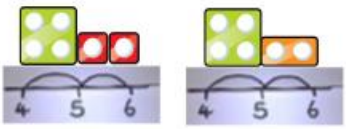
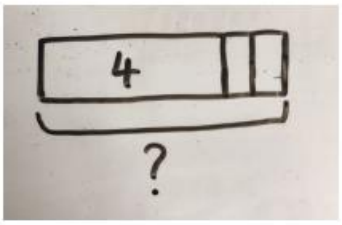
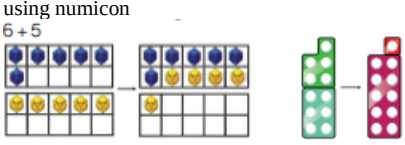
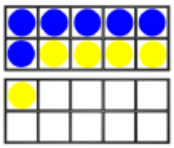
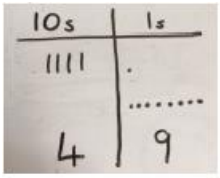
Key Stage 1
Children first learn to connect addition and subtraction with counting, but they soon develop two very important skills: an understanding of parts and wholes, and an understanding of unitising 10s, to develop efficient and effective calculation strategies based on known number bonds and an increasing awareness of place value. Addition and subtraction are taught in a way that is interlinked to highlight the link between the two operations. A key idea is that children will select methods and approaches based on their number sense. For example, in Year 1, when faced with 15 − 3 and 15 − 13, they will adapt their ways of approaching the calculation appropriately. The teaching should always emphasise the importance of mathematical thinking to ensure accuracy and flexibility of approach, and the importance of using known number facts to harness their recall of bonds within 20 to support both addition and subtraction methods. In Year 2, they will start to see calculations presented in a column format, although this is not expected to be formalised until KS2. We show the column method in Year 2 as an option; teachers may not wish to include it until Year 3.
Key Vocabulary: whole, part, ones, ten, tens, number bond, add, addition, plus, total, altogether, subtract, subtraction, find the difference, take away, minus, less, more

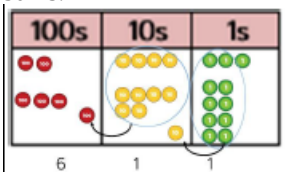
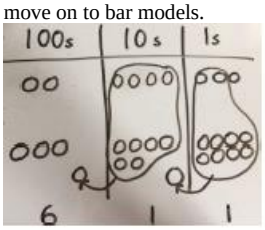
Lower Key Stage 2
In Year 3 especially, the column methods are built up gradually. Children will develop their understanding of how each stage of the calculation, including any exchanges, relates to place value. The example calculations chosen to introduce the stages of each method may often be more suited to a mental method. However, the examples and the progression of the steps have been chosen to help children develop their fluency in the process, alongside a deep understanding of the concepts and the numbers involved, so that they can apply these skills accurately and efficiently to later calculations. The class should be encouraged to compare mental and written methods for specific calculations, and children should be encouraged at every stage to make choices about which methods to apply. In Year 4, the steps are shown without such fine detail, although children should continue to build their understanding with a secure basis in place value. In subtraction, children will need to develop their understanding of exchange as they may need to exchange across one or two columns. By the end of Year 4, children should have developed fluency in column methods alongside a deep understanding, which will allow them to progress confidently in upper Key Stage 2.
Key Vocabulary: partition, place value, tens, hundreds, thousands, column method

Upper Key Stage 2
Children build on their column methods to add and subtract numbers with up to seven digits, and they adapt the methods to calculate efficiently and effectively with decimals, ensuring understanding of place value at every stage. Children compare and contrast methods, and they select mental methods or jottings where appropriate and where these are more likely to be efficient or accurate when compared with formal column methods. Bar models are used to represent the calculations required to solve problems and may indicate where efficient methods can be chosen.
Key Vocabulary: decimal, column methods, exchange, partition, mental method, ten thousand, hundred thousand, million

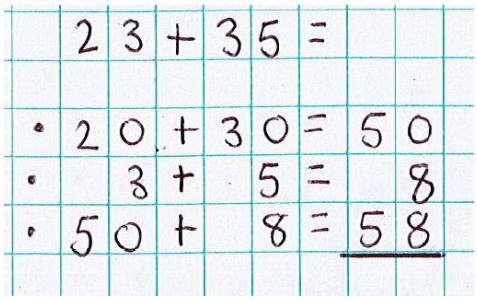
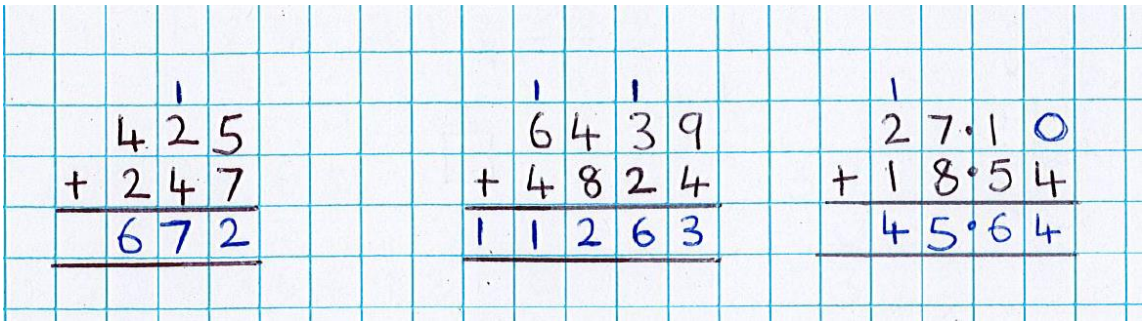
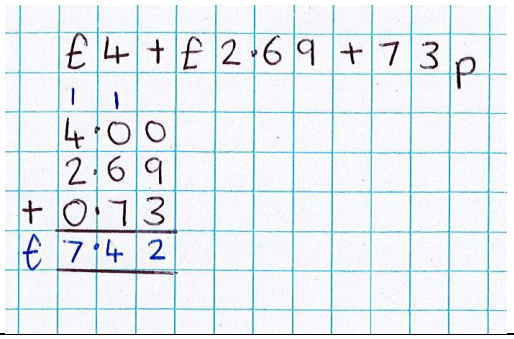
Implementation

Addition: Concrete and Pictorial methods

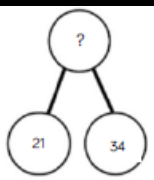
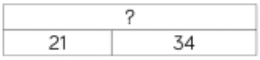
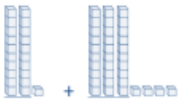
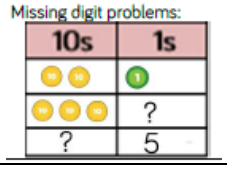
Concrete	Pictorial
Combining two parts to make a whole (use other resources too e.g. eggs, shells, cars) 	Children represent the cubes using dots or crosses within a part whole model. The dots can later be subsititued for numbers. 
Counting on using number lines and cubes or numicon  	A bar model encourages the children to count on rather than count all 
Regrouping to make 10; using ten frames and counters/cubes or using numicon 6 + 5 	Children to draw the ten frame and counters/cubes 
TO+O using base 10. Continue to develop understanding of partitioning and place value 41+8: 	Children to represent the base 10 e.g. using lines for tens and dots for ones. They can then move on to part whole model and bar models. 

TO +TO using base 10. Continue to develop understanding of partiotning and place value. 36+25: 	Children to represent the base 10 in aplace value chart and then move on to bar models. 

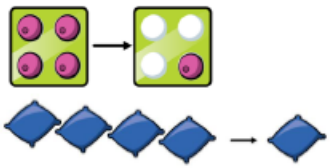
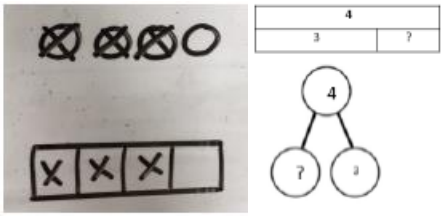
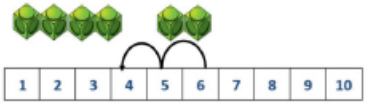
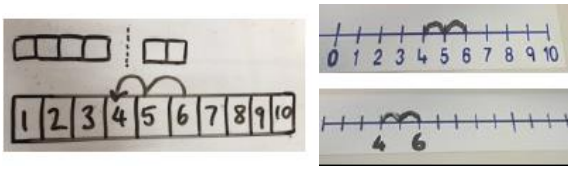
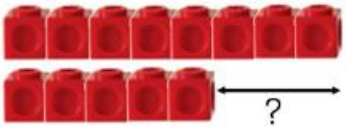
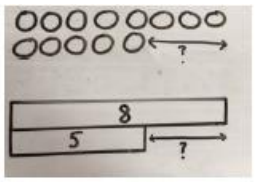
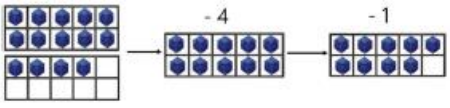
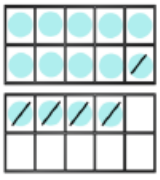
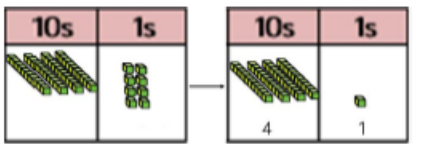
Addition: Abstract methods

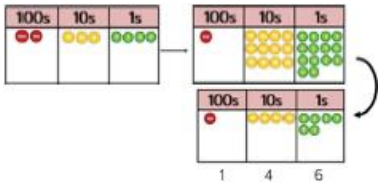
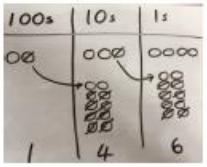
Partitioning develops mental maths skills and fosters a deeper understanding of the adding process.	
Formal written method: 	
Money 	

Conceptual Variation: different ways to ask children to solve 21+34

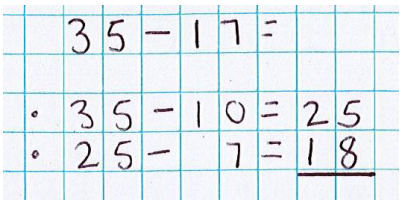
 	Word problem: In Year 3, there are 21 children and in Year 4, there are 34 children. How many children in total? 21+34=55. Prove it.	21 +34 21 + 34 = □ = 21 + 34 Calculate the sum of twenty-one and thirty-four	 Missing digit problems: 

Subtraction: Pictorial and concrete methods

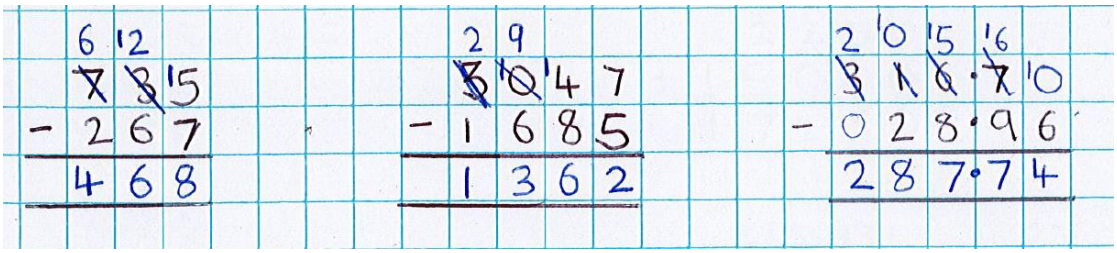
Concrete	Pictorial
Physically taking away and removing objects from a whole (ten frames, Numicon, cubes and other items such as beanbags could be used). 4-3=1 	Children to draw the concrete resources they are using and cross out the correct amount. The bar model can also be used. 
Counting back (using number lines or number tracks) children start with 6 and count back 2. 6 – 2 = 4 	Children to represent what they see pictorially e.g. 
Finding the difference (using cubes, Numicon or Cuisenaire rods, other objects can also be used). Calculate the difference between 8 and 5. 	Children to draw the cubes/other concrete objects which they have used or use the bar model to illustrate what they need to calculate. 
Making 10 using ten frames. 14 - 5 	Children to present the ten frame pictorially and discuss what they did to make 10. 
Column method using base 10. 48-7 	Children to represent the base 10 pictorially. 

Column method using place value counters. 234 – 88 	Represent the place value counters pictorially; remembering to show what has been exchanged. 

Subtraction: Abstract methods

Partition the smaller number and then subtract in steps	

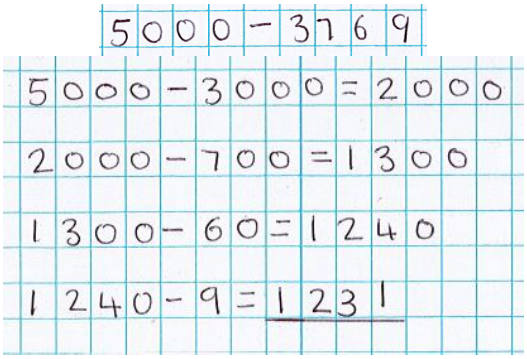
Formal written method:

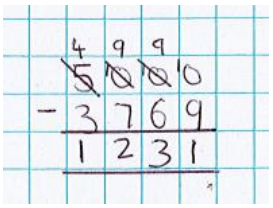


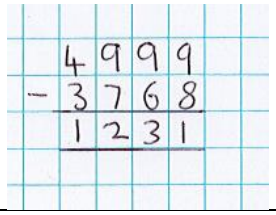
<u>Subtracting from a multiple of 100/1000/10,000</u>

Example: 5000-3769=

1. Partition the smaller number and then use number bond facts to subtract
2. Subtract using the formal written method in the standard way
3. Use the formal written method but first, subtract one from each number to avoid lots of borrowing.

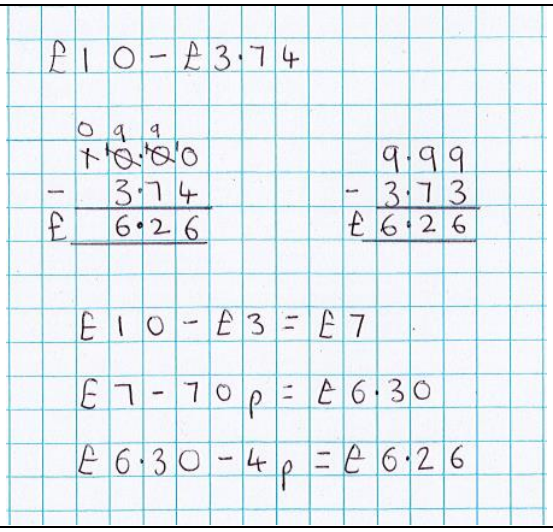




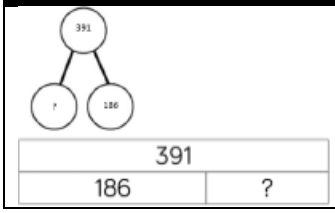


Subtracting from £5/£10/£20

1. Use the formal written method in the usual way
2. Subtract 1p from each number and the use the formal written method
3. Partition the second number and then use number bond knowledge to subtract each part.



Conceptual variation: different ways to ask children to solve 391-186



Raj spent £391, Timmy spent £186.
How much more did Raj spend?

Calculate the difference between 391 and 186.

□ = 391 - 186

391
-186

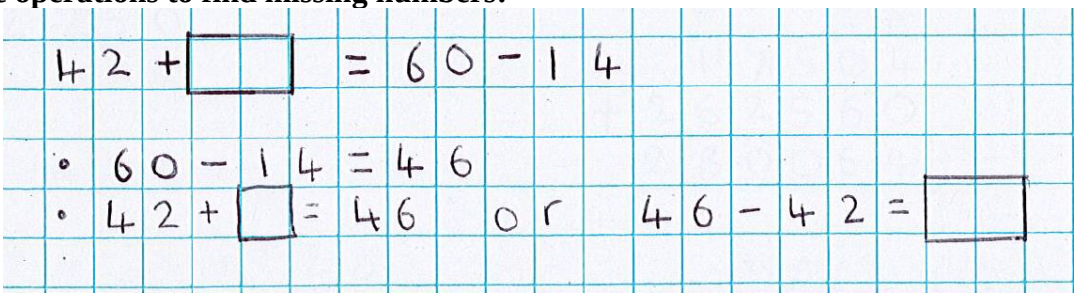
What is 186 less than 391?

Missing digit calculations

3 9 □
- □ □ 6
□ 0 5

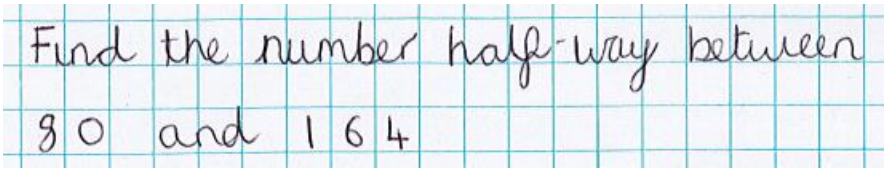
Applying subtraction and addition

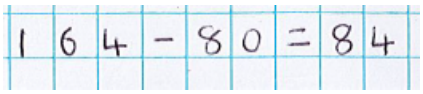
Use inverse operations to find missing numbers:

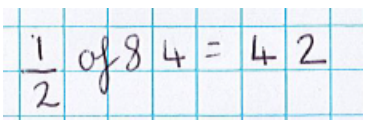


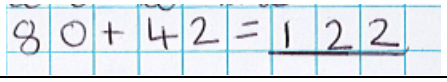
Half way numbers:

1. Find the difference
2. Half the difference
3. Add 'half the difference' to the smallest number









Multiplication and Division

Intent

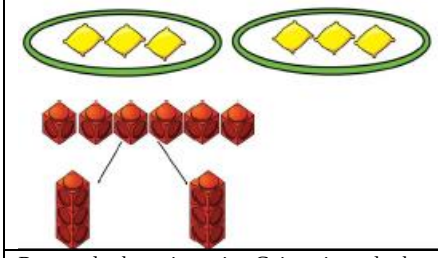
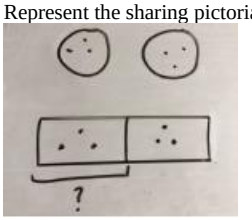
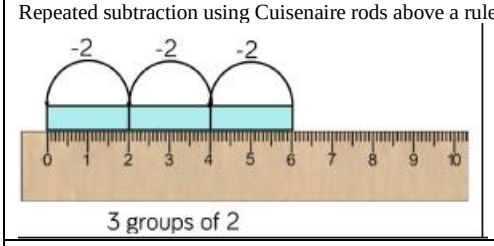
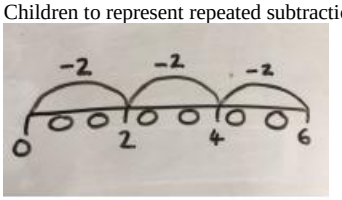
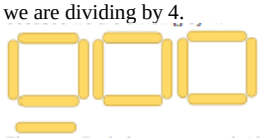
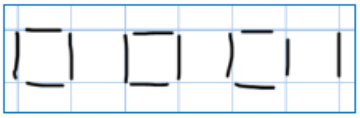
Key Stage 1
Children develop an awareness of equal groups and link this with counting in equal steps, starting with 2s, 5s and 10s. In Year 2, they learn to connect the language of equal groups with the mathematical symbols for multiplication and division. They learn how multiplication and division can be related to repeated addition and repeated subtraction to find the answer to the calculation. In this key stage, it is vital that children explore and experience a variety of strong images and manipulative representations of equal groups, including concrete experiences as well as abstract calculations. Children begin to recall some key multiplication facts, including doubles, and an understanding of the 2, 5 and 10 times-tables and how they are related to counting.
Key Vocabulary: group, share, equal, equals, is equal to, groups, equal groups, times, multiply, multiplied by, divide, share, shared equally, times-table

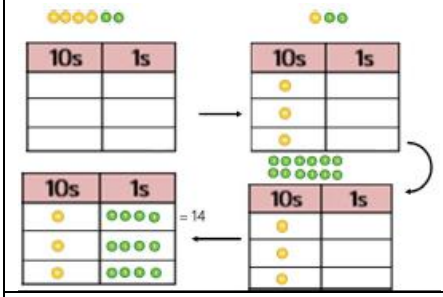
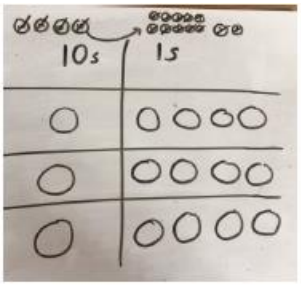
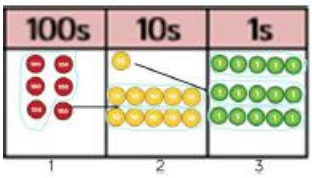
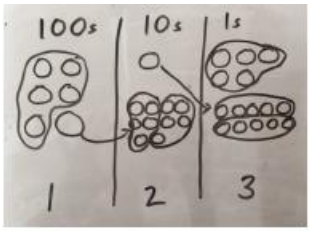
Lower Key Stage 2
Children build a solid grounding in times-tables, understanding the multiplication and division facts in tandem. As such, they should be as confident knowing that 35 divided by 7 is 5 as knowing that 5 times 7 is 35. Children develop key skills to support multiplication methods: unitising, commutativity, and how to use partitioning effectively. Unitising allows children to use known facts to multiply and divide multiples of 10 and 100 efficiently. Commutativity gives children flexibility in applying known facts to calculations and problem solving. An understanding of partitioning allows children to extend their skills to multiplying and dividing 2- and 3-digit numbers by a single digit. Children develop column methods to support multiplications in these cases. For successful division, children will need to make choices about how to partition. For example, to divide 423 by 3, it is effective to partition 423 into 300, 120 and 3, as these can be divided by 3 using known facts. Children will also need to understand the concept of remainder, in terms of a given calculation and in terms of the context of the problem.
Key Vocabulary: equal groups, sharing, grouping, bar model

Upper Key Stage 2
Building on their understanding, children develop methods to multiply up to 4-digit numbers by single-digit and 2-digit numbers. Children develop column methods with an understanding of place value, and they continue to use the key skill of unitising to multiply and divide by 10, 100 and 1,000. Written division methods are introduced and adapted for division by single-digit and 2-digit numbers and are understood alongside the area model and place value. In Year 6, children develop a secure understanding of how division is related to fractions. Multiplication and division of decimals are also introduced and refined in Year 6.
Key Vocabulary: factor, multiple, prime number, square number, cube number

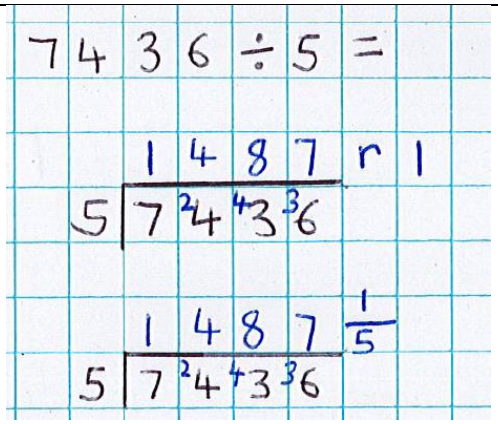
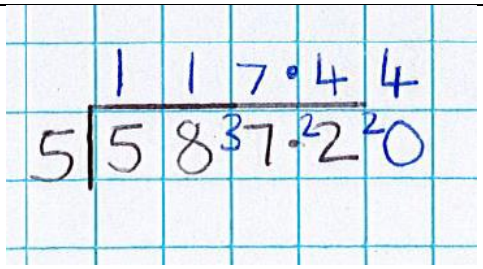
Implementation:

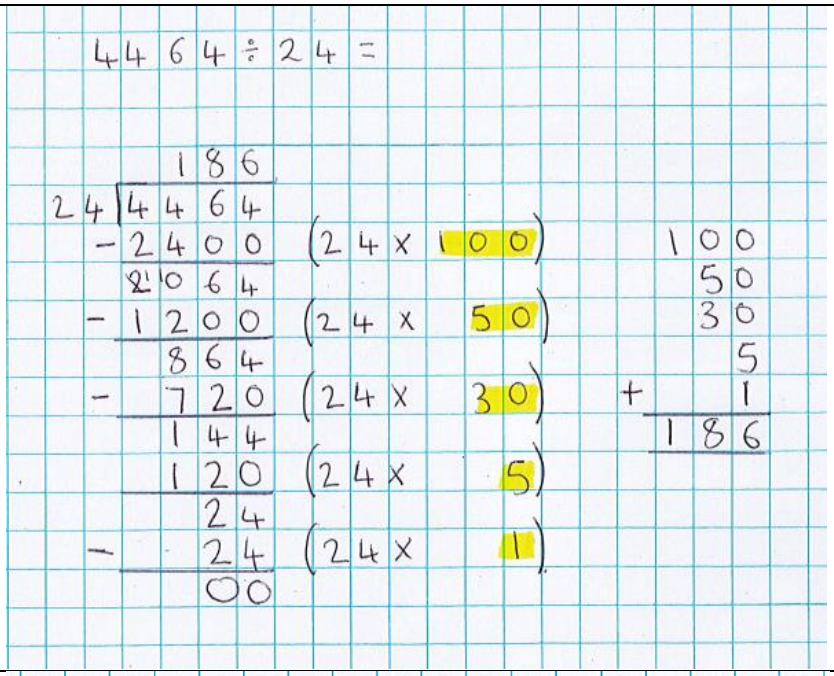
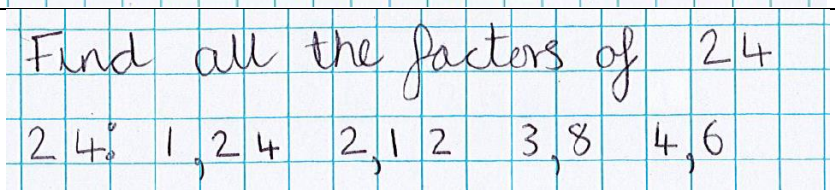
Division: concrete and pictorial methods

Concrete	Pictorial
Sharing using a range of objects. 6 ÷ 2 	Represent the sharing pictorially. 
Repeated subtraction using Cuisenaire rods above a ruler. 6 ÷ 2 	Children to represent repeated subtraction pictorially. 
2d ÷ 1d with remainders using lollipop sticks. Cuisenaire rods, above a ruler can also be used. 13 ÷ 4 Use of lollipop sticks to form wholes- squares are made because we are dividing by 4.  There are 3 whole squares, with 1 left over.	Children to represent the lollipop sticks pictorially.  There are 3 whole squares, with 1 left over.

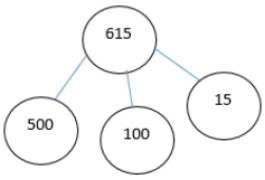
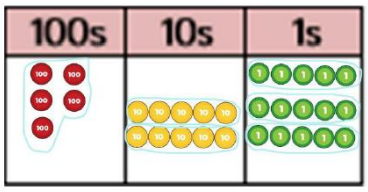
Sharing using place value counters. 42 ÷ 3 = 14 	Children to represent the place value counters pictorially. 
Short division using place value counters to group. 615 ÷ 5  1. Make 615 with place value counters. 2. How many groups of 5 hundreds can you make with 6 hundred counters? 3. Exchange 1 hundred for 10 tens. 4. How many groups of 5 tens can you make with 11 ten counters? 5. Exchange 1 ten for 10 ones. 6. How many groups of 5 ones can you make with 15 ones?	Represent the place value counters pictorially. 

Division: abstract methods

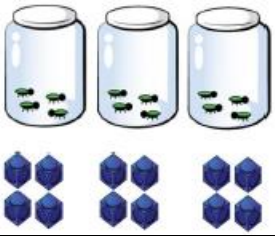
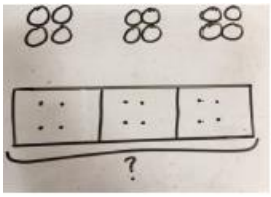
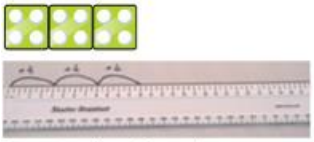
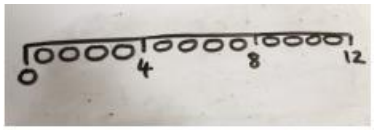
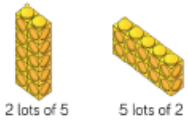
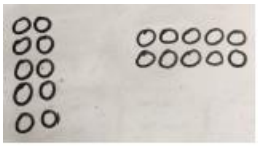
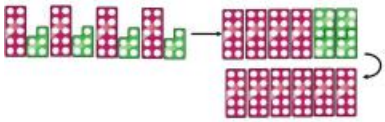
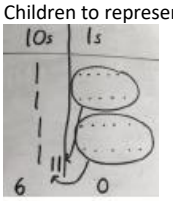
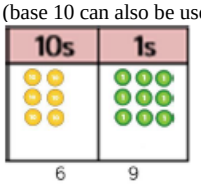
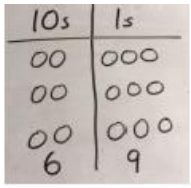
Formal written method (Bus-stop method) Once children are confident with remainders, they can be expressed as a fraction	
Dividing decimal numbers using the bus-stop method (if there is a remainder, add another 0 to the number 'inside' the bus stop)	

Long division using 'chunking'. The multiple of the divisor subtracted each time depends on the known number facts e.g. if you know x10 of a number, you can halve it to find x5 of that number)	
Factors Write factors out in pairs always starting with one and itself	

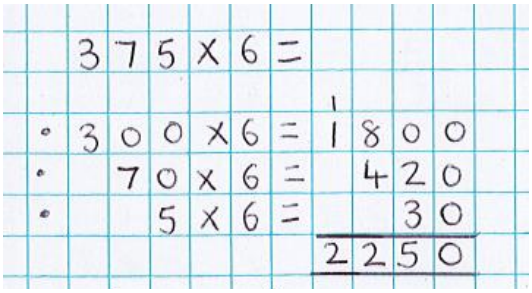
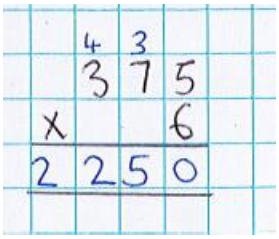
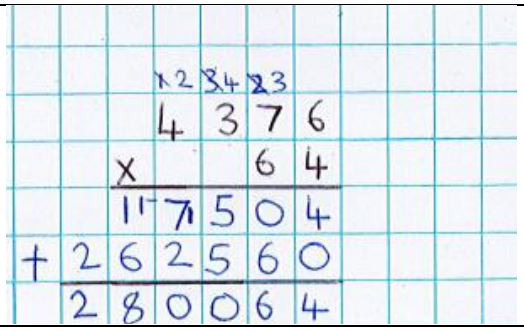
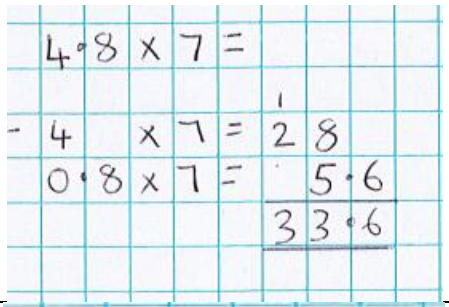
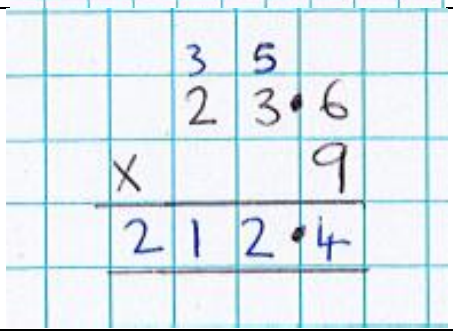
Conceptual variation: different ways to ask children to solve 615÷5

Using the part whole model below, how can you divide 615 by 5 without using short division? 	I have £615 and share it equally between 5 bank accounts. How much will be in each account? 615 pupils need to be put into 5 groups. How many will be in each group?	$5\overline{)615}$ 615 ÷ 5 = ☐ = 615 ÷ 5	What is the calculation? What is the answer? 

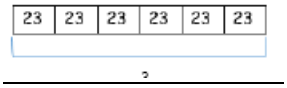
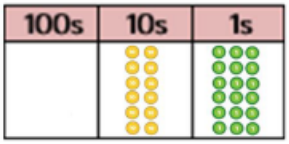
Multiplication: concrete and pictorial methods

Concrete	Pictorial
Repeated grouping/repeated addition 3 × 4 4 + 4 + 4 There are 3 equal groups, with 4 in each group. 	Children to represent the practical resources in a picture and use a bar model. 
Number lines to show repeated groups- 3 × 4 	Represent this pictorially alongside a number line e.g.: 
Use arrays to illustrate commutativity counters and other objects can also be used. 2 × 5 = 5 × 2 	Children to represent the arrays pictorially. 
Partition to multiply using Numicon, base 10 or Cuisenaire rods. 4 × 15 	Children to represent the concrete manipulatives pictorially. 
Formal column method with place value counters (base 10 can also be used.) 3 × 23 	Children to represent the counters pictorially. 

Multiplication: abstract methods

Partitioning- this method develops mental maths skills as well as fostering a deeper understanding of the multiplication process	
Short multiplication	
Long multiplication Some children use a small blob of blu-tac to hide the digit they are not multiplying by. Once children have multiplied by the ones digit, they cross out the carry overs and 'drop the zero' before multiplying by the tens digit.	
Multiplying a decimal number using partitioning	
Multiply a decimal number using short multiplication	

Conceptual variation: different ways to ask children to solve 6 x23

	Mai had to swim 23 lengths, 6 times a week. How many lengths did she swim in one week? With the counters, prove that 6 x 23 = 138	Find the product of 6 and 23 6 × 23 = □ = 6 × 23 6 × 23 23 × 6	What is the calculation? What is the product? 

Fractions

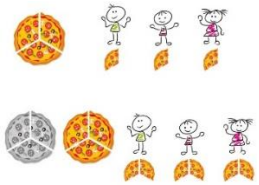
Intent

Key Stage 1
In Year 1, children encounter halves and quarters, and link this with their understanding of sharing. They experience key spatial representations of these fractions, and learn to recognise examples and non-examples, based on their awareness of equal parts of a whole. In Year 2, they develop an awareness of unit fractions and experience non-unit fractions, and they learn to write them and read them in the common format of numerator and denominator.
Key Vocabulary: whole, parts, equal, share, half, quarter

Lower Key Stage 2
Children develop the key concept of equivalent fractions, and link this with multiplying and dividing the numerators and denominators, as well as exploring the visual concept through fractions of shapes. Children learn how to find a fraction of an amount, and develop this with the aid of a bar model and other representations alongside. in Year 3, children develop an understanding of how to add and subtract fractions with the same denominator and find complements to the whole. This is developed alongside an understanding of fractions as numbers, including fractions greater than 1. In Year 4, children begin to work with fractions greater than 1. Decimals are introduced, as tenths in Year 3 and then as hundredths in Year 4. Children develop an understanding of decimals in terms of the relationship with fractions, with dividing by 10 and 100, and also with place value.
Key Vocabulary: whole, parts, equal groups, parts, denominator, numerator, decimal

Upper Key Stage 2
Children find fractions of amounts, multiply a fraction by a whole number and by another fraction, divide a fraction by a whole number, and add and subtract fractions with different denominators. Children become more confident working with improper fractions and mixed numbers and can calculate with them. Understanding of decimals with up to 3 decimal places is built through place value and as fractions, and children calculate with decimals in the context of measure as well as in pure arithmetic. Children develop an understanding of percentages in relation to hundredths, and they understand how to work with common percentages: 50%, 25%, 10% and 1%.
Key Vocabulary: whole, parts, equal groups, parts, denominator, numerator, decimal, improper fraction, mixed number tenths, hundredths, percentage

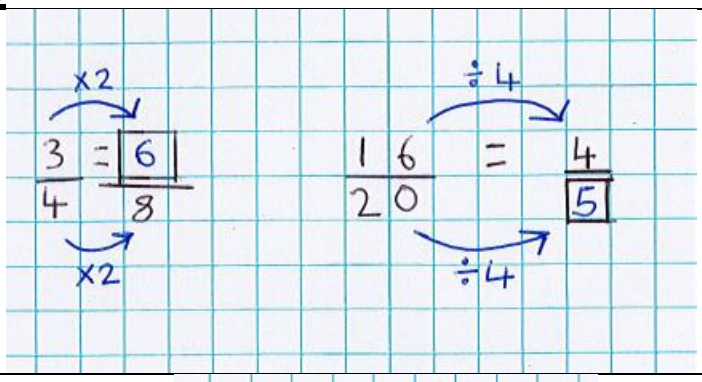
Fractions: pictorial and concrete methods

Concrete	Pictorial
Use sharing to explore the link between fractions and division. *1 whole shared between 3 people.* *Each person receives one-third.* 	Use a bar model and other fraction representations to show the link between fractions and division.  $1 \div 3 = \frac{1}{3}$

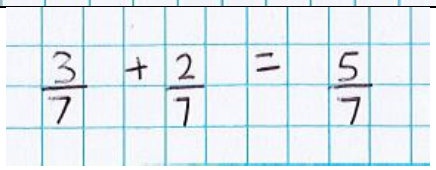
Fractions: abstract methods

Finding equivalent fractions

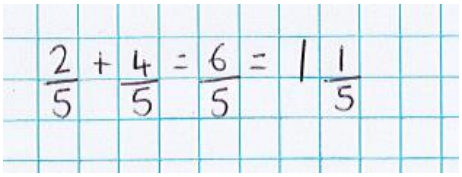
Chant: "whatever you do to the bottom, you do to the top."



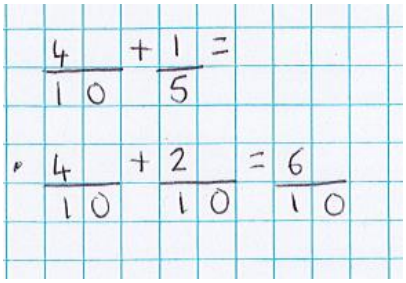
Adding fractions

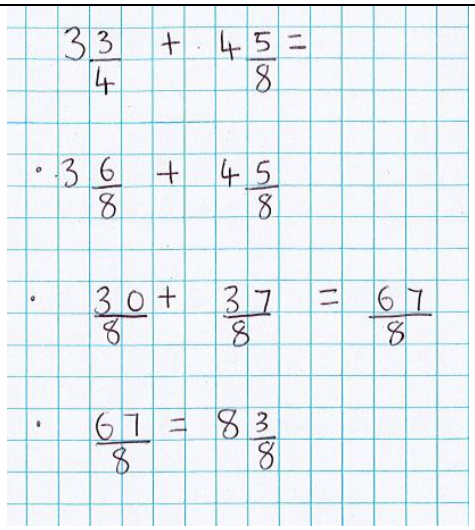
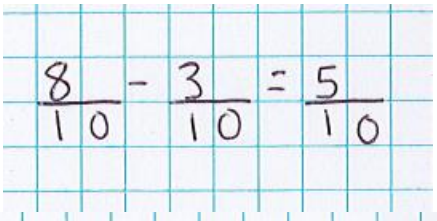
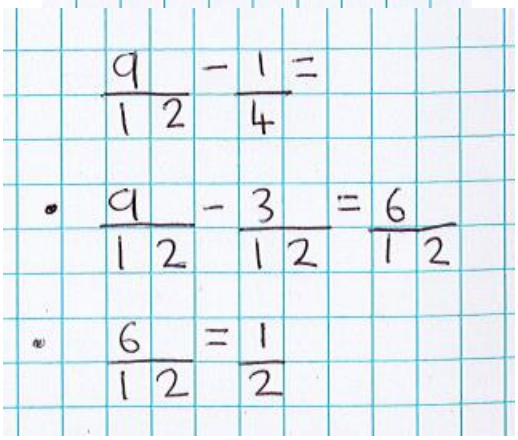


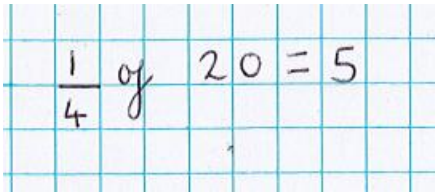
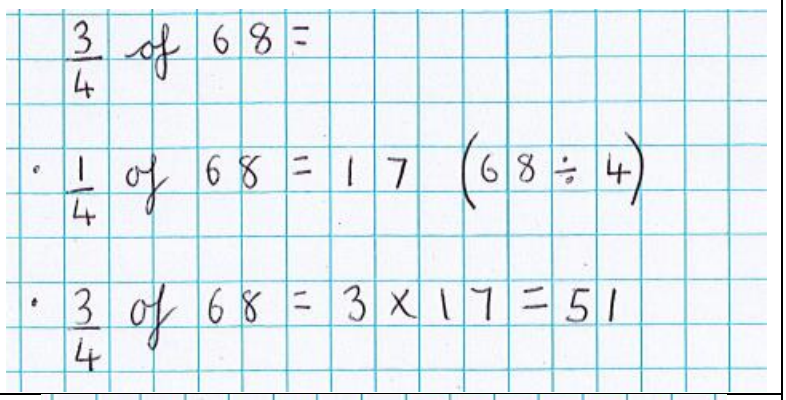
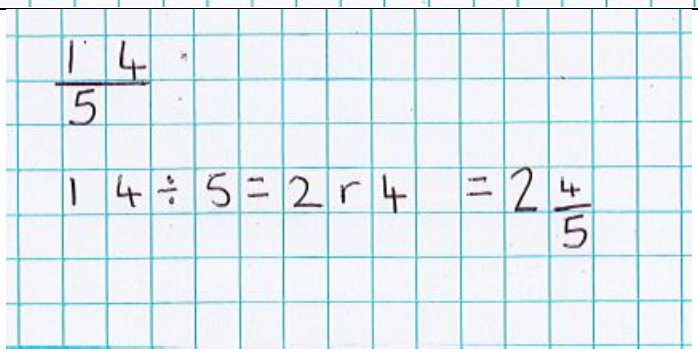
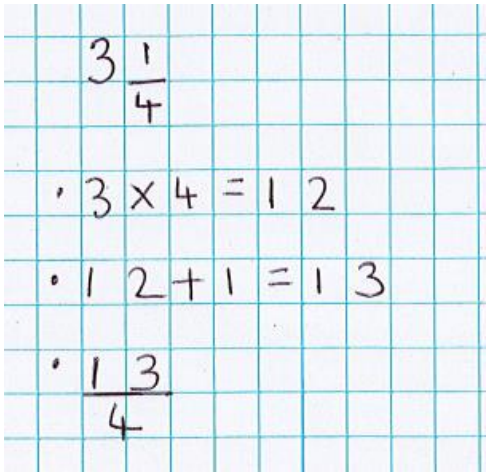
When the answer is an improper fraction, convert it to a mixed number

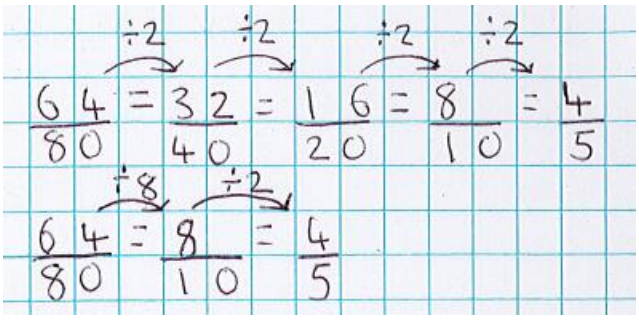
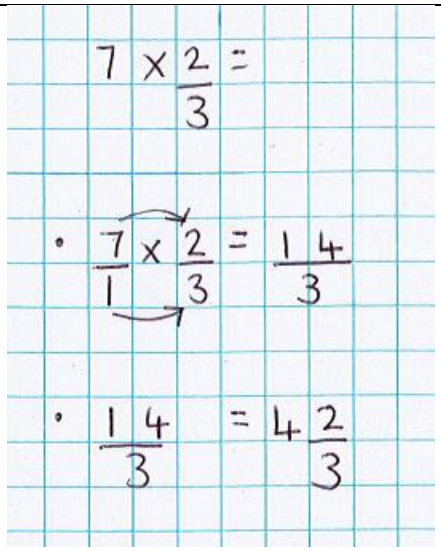
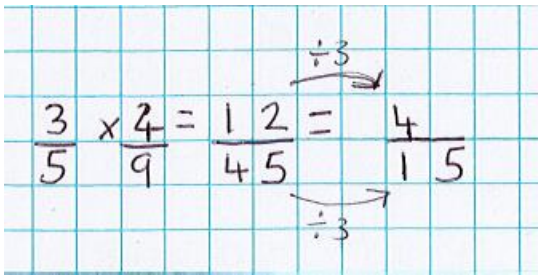
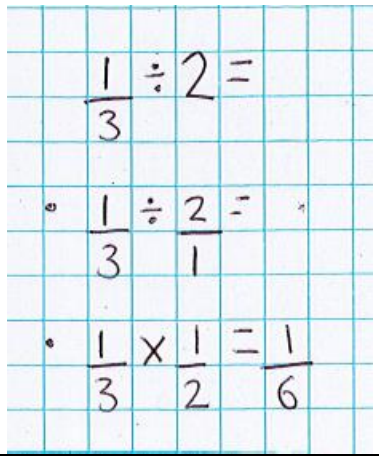


When the denominators are different, find a common denominator before adding



When the numbers are mixed numbers, convert to improper fractions before adding then convert back to a mixed number	
Subtracting fractions If the denominators are different, find a common denominator before subtracting	 

Fraction of an amount Remind children of the chant: "Divide by the bottom, times by the top."	 
Convert an improper fraction to a mixed number	
Convert a mixed number to improper fraction	

Simplifying fractions Some children may need to use several steps, whilst others may recognise larger common factors of the numerator and denominator	
Multiplying fractions When multiplying a fraction by a whole number, re-write the whole number as a fraction with a denominator of 1 Once the numerators have been multiplied and the denominators have been multiplied, children should simplify the answer if possible	 
Dividing a fraction by an integer Turn the integer into a fraction (with one as the denominator) KFC- keep, flip, change Keep the first fraction, flip the second fraction and change the division to multiplication.	

Impact

All teachers and teaching assistants are using the same strategies and approaches when teaching and supporting children with their maths. The children are therefore able to build on these methods and deepen their understanding as the move through the school. Fewer errors will be made and fewer misconceptions will arise as there will be a consistent approach across all year groups. The strengthened understanding of these concepts will in turn lead to improved problem solving and reasoning skills.

Equal Opportunities

At St Michael's School we believe that every individual within the school has the opportunity to achieve their full potential and has the same chance and equal access to all areas of the curriculum.

Disability Equality Impact Assessment

This policy has been written with reference to and in consideration of the school's Disability Equality Scheme. Assessment will include consideration of issues identified by the involvement of disabled children, staff and parents and any information the school holds on disabled children, staff and parents.

Subject Leader – Mrs Parker