Progression of Calculations through Reigate St Mary's

REIGATE ST MARY'S
PREPARATORY AND CHOIR SCHOOL

Formal methods of Calculations Guidance

Policy Author:	Annette Wright, Deputy Head Caroline Saunders, Lower School Maths Coordinator
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Rationale

At St Mary's, we believe a clear progression in calculation will support the learning and teaching of Maths throughout the school, allow clarity and provide a secure foundation upon which to build and develop mathematical skills. The aim is to have a steady progression of understanding in Maths as your child moves through school. Different methods are taught, but they have been chosen to build on one another, according to the level your child is working at, rather than which year group they are in.

This policy contains the key pencil and paper procedures that will be taught within St Mary's and should be read alongside the Maths Policy. Although the focus of the policy is on pencil and paper procedures it is important to recognise that the ability to calculate mentally lies at the heart of the Maths framework. In every written method there is an element of mental processing. Sharing written methods with the teacher encourages children to think about the mental strategies that underpin them and develop innovative ideas. Therefore, written recording both helps children to extend and clarify their thinking. Children should be encouraged to see mathematics as both a written and a spoken language.

Teachers should support and guide children through the following stages:

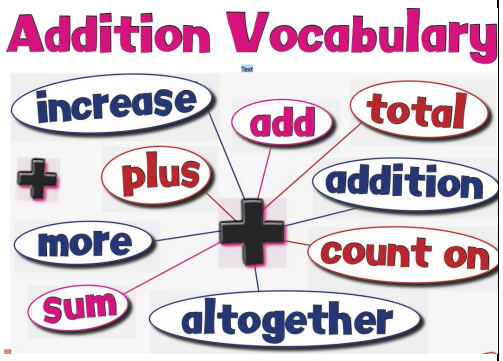
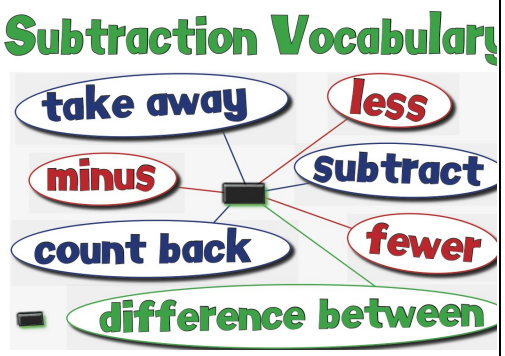
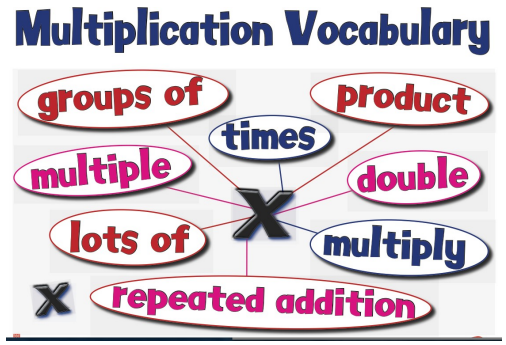
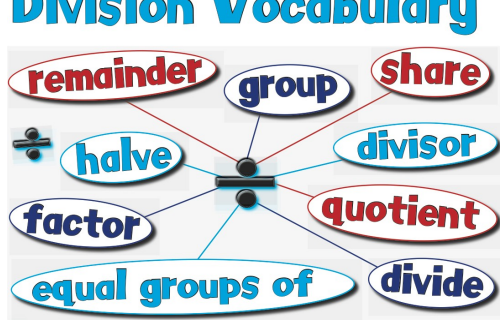
1. Develop the use of pictures and use of words and symbols to represent numerical activities.
2. Use standard symbols and conventions.
3. Use of jottings to aid a mental strategy.
4. Use of pencil and paper procedures.
5. It is important that children do not abandon jottings and mental methods once other pencil and paper procedures are introduced. Children will always be encouraged to look at a calculation/problem and then decide on the best method.

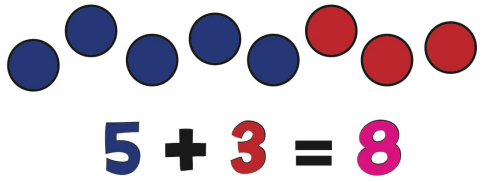
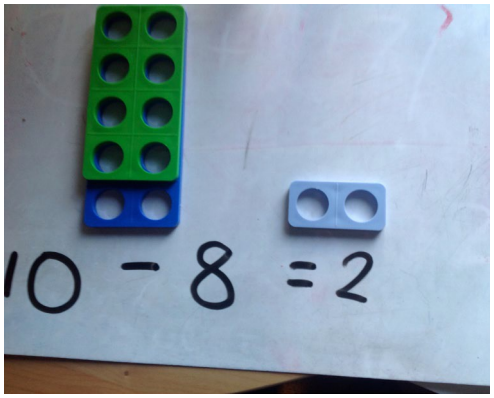
Progression in calculation should include:

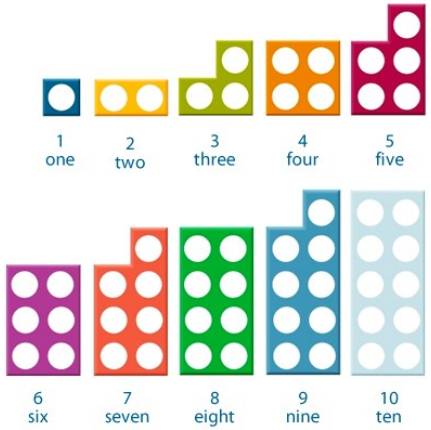
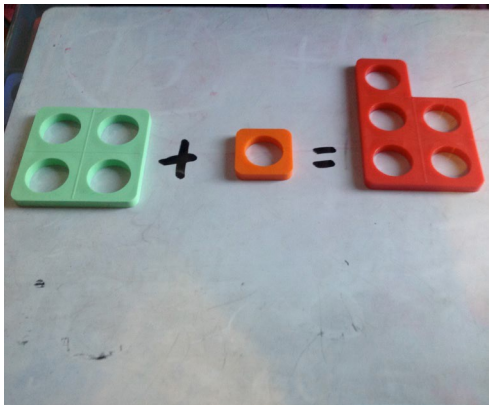
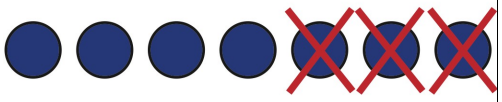
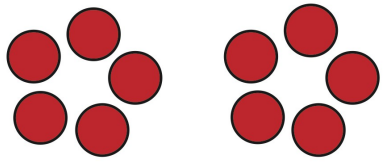
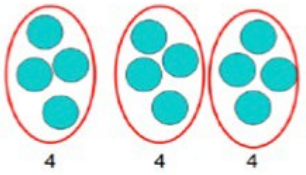
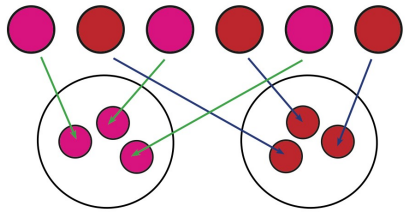
A range of mental strategies to be used as a first resort, even once written methods have been introduced and embedded.

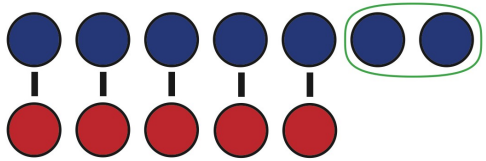
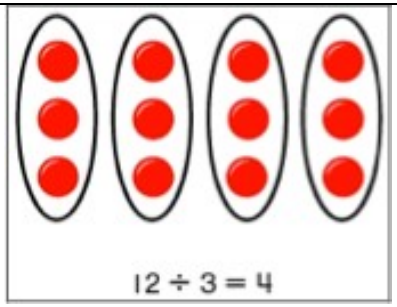
1. An ability to understand and use the relationships between the four operations of number.
2. An ability to explain, describe and record their methods.
3. An ability to estimate and check whether the answer is correct.
4. An ability to solve a wide range of problems involving calculation in a wide variety of contexts.
5. An ability to choose and use the most appropriate method of calculation; mental, jottings, written or using a calculator.
6. An ability to take the initiative to return to an earlier method that children are more confident with.

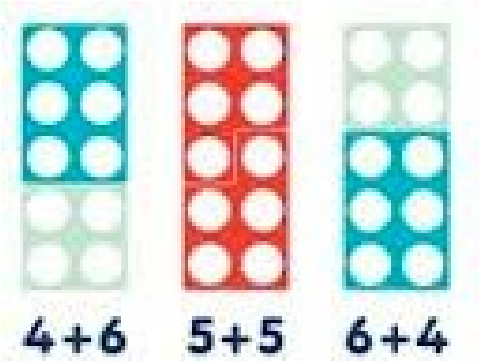
This policy shows the progression in each operation (addition, subtraction, multiplication, and division.) All methods should be taught with understanding rather than by rote and put into real life contexts. Differentiated outcomes throughout the progression will be the size of the numbers the children are using.

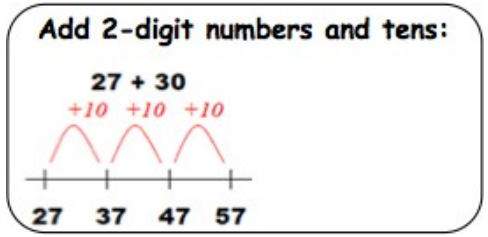
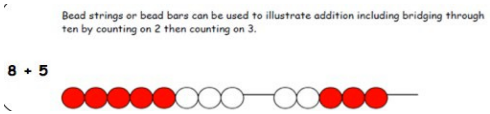
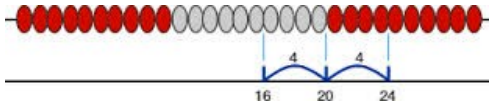
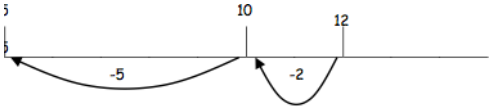
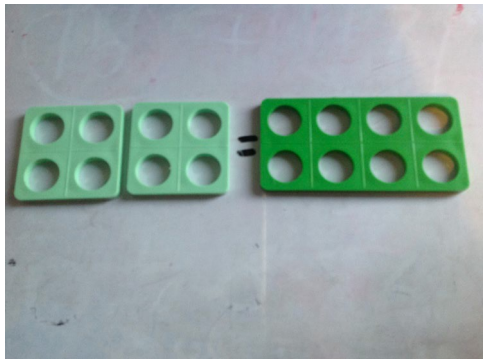
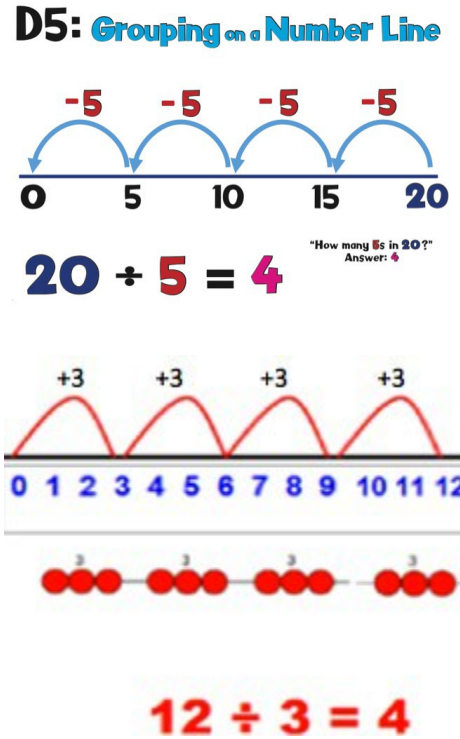
STAGE	Addition	Subtraction	Multiplication	Division
				

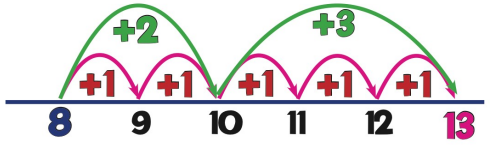
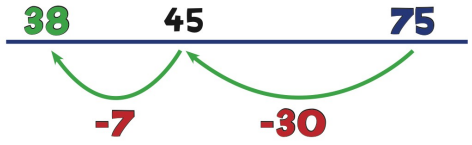
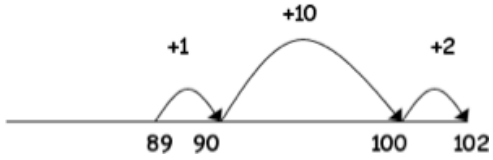
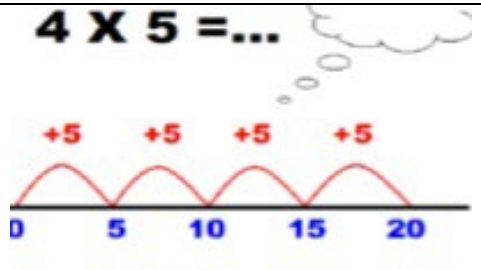
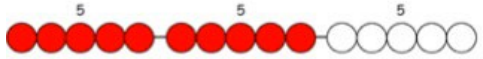
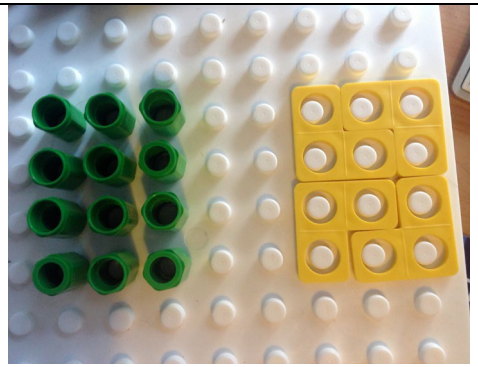
	Addition	Subtraction	Multiplication	Division
1	Children are encouraged to develop a mental picture of the number system in their head for calculation. They develop ways of recording calculations using pictures, Numicon etc They handle objects for early addition work. **A1a: Largest Number 1st**  **5 + 3 = 8**	Before children can move onto the methods for subtraction, they need to be able to count reliably including one to one. The children will be supported with these concepts through singing Nursery Rhymes and develop ways of recording calculations using pictures or using apparatus, such as Numicon correspondence.  Children will be able to count up or	Children will experience equal groups of objects. They will count in 2s and 10s and begin to count in 5s. They will work on practical problem-solving activities involving equal sets or groups. Numicon will be used to help the children to visualise the grouping of numbers and to support counting on as repeated addition.  	Children will understand equal groups and share items out in play and problem solving. They will count in 2s and 10s and later in 5s. They will experience the language of sharing early on; sharing of toys, fruit etc, and will have experienced the idea of groups – by working in a practical way practical way group with an adult or sorting toys or objects into groups of the same colour for instance. They will draw pictures in groups or sets. Division will be explored using grouping (with numicon, then number line)

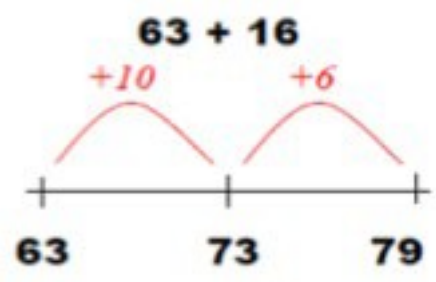
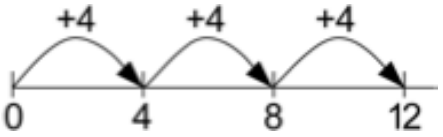
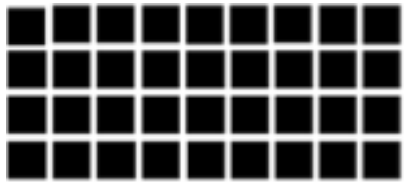
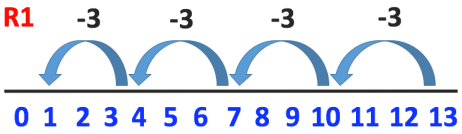
	Addition	Subtraction	Multiplication	Division
	  They use numberlines (Slide C1A) and practical resources to support calculation and teachers demonstrate the use of a numberline.	back from any number  Children will understand subtraction as taking away Children will begin to know the inverse relationship of number facts to 20 Children will subtract numbers using equipment and Numicon (start by subtracting the units first in preparation for later work). **S1: Objects**  **7 - 3 = 4** "What do I get if I take 3 away from 7? Answer: 4"	 Numicon tiles are essential for making lots of and aiding the counting in fives and other numbers. **(M1: Groups)**  "2 groups of 5 counters makes 10 counters altogether"	Grouping:  Sharing:  12 shared between 3 is 4 A child groups the objects by sorting. **D1: Sharing (Concept)**  "If I share 6 into 2 equal amounts, how many in each group?" Answer: 3

	Addition	Subtraction	Multiplication	Division
	C1a: Number Order  The Numbers must be said once and always in the conventional order. Children need to **count on** from any number, combining two groups (slide c6) **C6: Counting On**  Children will recognise that addition can be done in any order. Children will begin to know addition facts to ten. Children will be able to count on in	**S2: What's the Difference?**  7 - 5 = 2 "How many more is 7 than 5? What is the difference?"		 Children will halve numbers and work out simple fractions of numbers

	Addition	Subtraction	Multiplication	Division
	ones on a numbered line. Children will be able to use more efficient jumps, starting with the larger number and counting on in ones.  			
2	Children are encouraged to develop a mental picture of the number system in their head for calculation. They develop ways of recording calculations using pictures, numicon etc (slide A1a) Pupils to recognize the effect of adding and subtracting zero Children then begin to use numbered lines to support their own calculations using a numbered line to count on in	Children are encouraged to develop a mental picture of the number system in their head for calculation. They develop ways of recording calculations using pictures, numicon etc The numberline should be used to show that 6-3 means the difference between 3 and 6 and how many jumps they are apart.	Children will experience equal groups of objects They will count in 2s and 10s and begin to count in 5s. They will work on practical problem-solving activities involving equal sets or groups. Numicon will be used to help the children to visualise the grouping of numbers and to support counting on as	The children will be able to divide objects into equal groups They use counters, bears, Numicon or other objects to group with to solve problems. They will begin to recognise how times- table facts can help them and see the inverse relationship between division and multiplication.

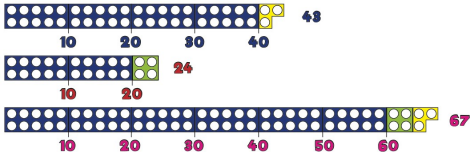
	Addition	Subtraction	Multiplication	Division
	Children can count on using a marked unlabelled **number line**, then by drawing their own number lines  Bead strings can be used to illustrate addition including bridging through ten.  They begin to use jumps of various sizes, applying number bond knowledge to help them 'bridge' to the next 5 or 10. (slide A2a)	Bead strings can be used to illustrate subtraction using bridging through ten by counting back 4 then counting back 4. 24-8=16  Children can count back using a marked unlabeled number line, then by drawing their own They use their knowledge of number patterns to count  *Empty number line* back in different sized jumps.	repeated addition  The children will understand double as two equal groups of objects or numbers. They will be able to draw arrays. The children will be able to represent jumps of 2, 5 and 10 on a numbered number line and relate it to the concept of **repeated addition**.	Groupings using a number line 

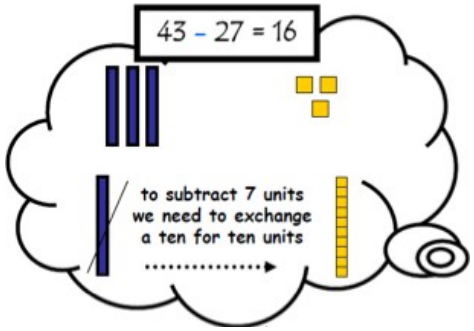
	Addition	Subtraction	Multiplication	Division
	A2a: Counting On Bridging 10  **8 + 5 = 13** Pupils will understand the words sum and total Pupils count in fractions up to 10	**S7: Backwards Jump**  **75 - 37 = 38** Where the numbers are involved in the calculation are close together or near to multiples of 10, 100 etc counting on using a number line should be used. 102 – 89 = 13 	**4 X 5 =...**  **4 X 5 = 20**  They will see the relationship between addition and multiplication: 2+2+2+2+2=10 being the same as 5 x 2= 10. Numicon tracks and Cuisenaire Rods will help the children to visualise the grouping and repeated addition concept.	 Or as shown on the Numicon 12 divided by 3 = 4 Or repeated subtraction e.g. 12 take away 3, take away3 more, take away 3 more and take away 3

3	Children will begin to use empty number lines themselves starting with the larger number and counting on First counting on in tens and ones Then helping children to become more efficient by adding the units in one jump (by using known facts e.g., 3+4 = 7) Followed by adding the tens in one jump and the units in one jump. Bridging through ten can help the children to become more efficient.  	Children will use partitioning to see how numbers are broken down into their different values. Children will be introduced to expanded subtraction. **(S10: Expanded Subtraction)** Additional 87 - 23 = 64 80 7 20 3 60 4 **(S10: Expanded Subtraction)** Additional:a 75 - 37 = 38 60 ~~70~~ 15 30 7 30 8	Children will develop their understanding of multiplication and use jottings to support calculation Repeated addition  4 times 9 is 9+9+9+9 or 9 lots of 4 or 4x9  Children will be comfortable with the concept of multiplying and dividing by powers of ten	Children will develop their understanding of division and use jottings to support calculation Sharing equally 6 sweets shared between 2 people, how many do they each get? Repeated addition using a number line or beads **Grouping on a number line** 13 ÷ 3 = 4 r 1  Using symbols to stand for unknown numbers to complete equations using inverse operations Short division for larger 2 digit numbers Bus shelter method The number being divided (the dividend) in the middle (under the shelter). 2.Start by looking at the most significant number and work out how many times it can go into the number.

D: Numicon

43 + 24 = 67





MM1a: Jump!

	TTh	Th	H	T	U	.	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	$\frac{1}{10000}$
x1000	6	3	4	0	0					
x100		6	3	4	0					
x10			6	3	4					
				6	3	.	4			
÷10					6	.	3	4		
÷100					0	.	6	3	4	
÷1000					0	.	0	6	3	4

M5: Grid Method

Short Multiplication

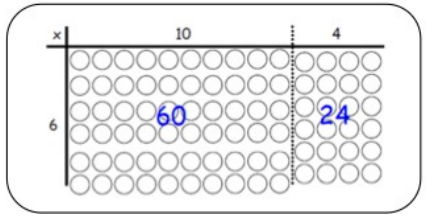
15 x 5 = 75

x	10	5
5	50	25

50 + 25 = 75

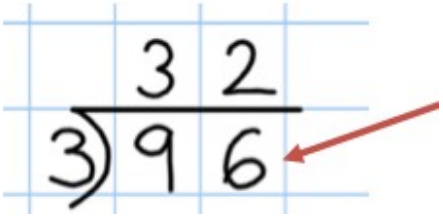
Arrays

Link the layout of the grid to an array initially:

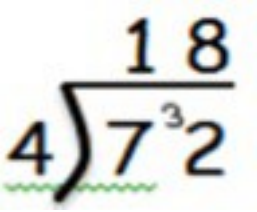


Carry over the remainders.

Short division: Limit numbers to NO remainders in the answer OR carried (each digit must be a multiple of the divisor).



Moving to remainders



			Children should be able to model a multiplication calculation using an array. This later supports the grid method. **M5a: Grid Method** Short Multiplication **43 x 6 = 258** | x	40	3
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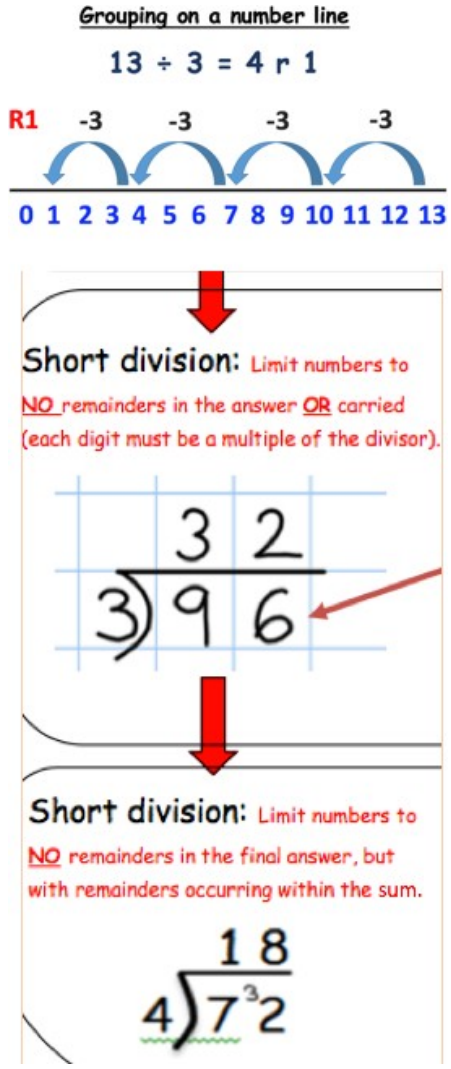
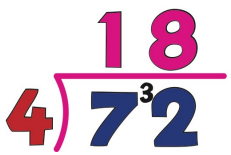
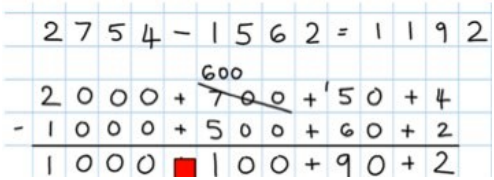
6	240	18	 **240 + 18 = 258** They will be able to use times table knowledge to be able to multiply larger numbers by partitioning. They will use arrays to help them visualise this.	

				(D10: Short Division) Additional 72 ÷ 4 = 18 

4	Children will continue to use empty number lines with increasingly large numbers, including compensation where appropriate Count on from the largest number irrespective of the order of the calculation Children will use partitioning to see how numbers are broken down into their different values. Children will be introduced to the expanded column method for larger numbers before moving quickly onto the formal column method as they will then have developed an understanding of the process **A6: Expanded Column** Addition H T U 687 + 248 15 120 800 935 Adding the least significant digits first in preparation for 'carrying.' Formally moving to the column method	Children will continue to use empty number lines with increasingly large numbers They will use the expanded column method (known as decomposition) to partition the number and subtract each place value separately always starting with the least significant digits (e.g. the units). It is very important they understand the importance of keeping the digits lined up.  First they will work with numbers that have no exchanging (e.g. the units or tens of the number being subtracted is smaller than the starting number). Next they will learn how to exchange from the tens to the units. They need to recognise when the starting number's units have less than the number being subtracted. When this is the case they need to '**exchange**' 10 from the tens into the units, in order to be able to subtract the numbers. It	Children will become confident with the grid method **Developing the grid method:** Eg. 136 x 5 = 680 | X	100	30	6
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5	500	150	30 | 500 150 + 30 680 **M5: Grid Method** Short Multiplication 15 x 5 = 75 | x	10	5
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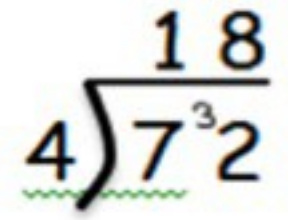
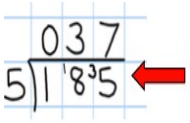
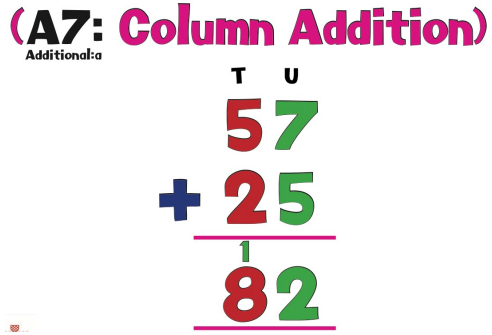
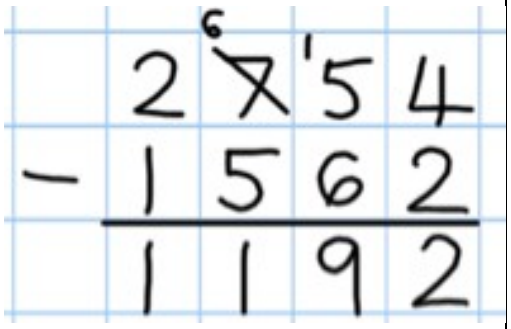
5	50	25	 50 + 25 = 75	The children will understand how to deal with **remainders in a real life context**   When the answer for the **first column** is zero (1 ÷ 5, as in example), children could initially write a zero above to acknowledge its place, and must always 'carry' the number (1) over to the next digit as a remainder.

	of addition(Slide A7) 	is important the children understand the tens have to come over to the units as a whole 10. The Base 10 (Dienes) apparatus helps the children to visualise what happens and how the exchange takes place. We also use place value counters.  Once the children understand this process of exchanging, they will often do it in one go to save time.		
5	Move from expanded addition to the compact column method, **adding units first**, and carrying numbers **above** the calculation. Also include money and measures contexts.	Children will be able to subtract using the **Compact Decomposition Method** and understand the importance of lining up each digit.	Children will continue to use arrays where appropriate using the grid method of multiplication Grid method as stage 4 HTU x U	Continue to develop short division/ bus stop method This method relies heavily on times tables knowledge - 2 digit numbers divided by single digit <u>Then</u> 3 digits divided by a single digit

A7e: Column Addition

M	HTh	TTh	Th	H	T	U
	7	8	7	5	6	7
+	4	4	6	2	7	8
1	1	1		1	1	
1	2	3	3	8	4	5

S11: Column Subtraction

	H	T	U
	6	11	1
	7	~~2~~	3
-	3	5	6
	3	6	7

M5b: Grid Method

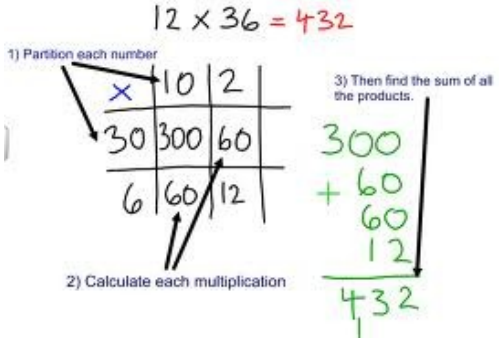
Short Multiplication

147 x 4 = 588

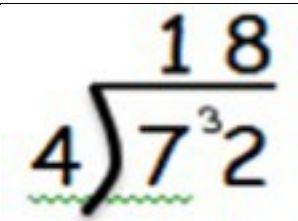
x	100	40	7
4	400	160	28

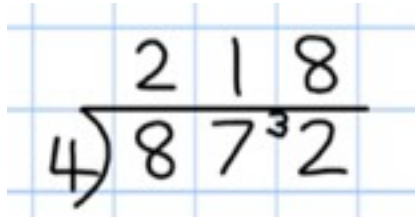
400 + 160 + 28 = 588

Then TU x TU

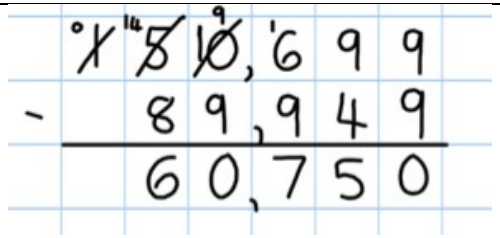


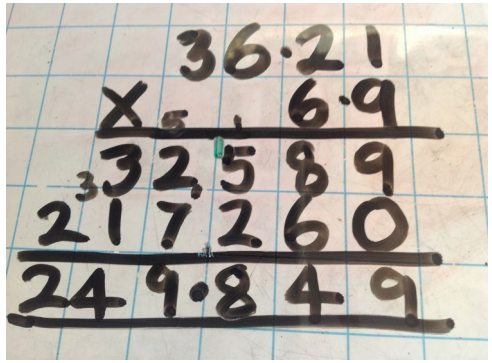
Column multiplication is introduced





			M7: Column Multiplication H T U 1 4 7 x 4 1 2 5 8 8	
6	**Add numbers with more than 4 digits** including money, measures and decimals with different numbers of decimal places. The decimal point should be aligned in the same way as the other place value columns and must be in the same column in the answer.	The children will be using the **Compact Decomposition Subtraction** method to solve subtractions of decimal numbers and more complex numbers. **S11d: Column Subtraction** Th H T U 4 ~~5~~ 9 13 1 ~~5~~ 0 ~~4~~ 2 - 1 7 7 6 3 2 6 6	Column multiplication linked to grid multiplication  	138÷6 0 2 3 / 6) 1 3 8 Short division involving remainders **(D10: Short Division)** Additional:a 65 ÷ 4 = 16r1 1 6r1 / 4) 6 5 (2) **Short division with remainders:** Now that pupils are introduced to examples that give rise to remainder answers,

	A7j: Column Addition With Decimals 73.4 + 5.67 = 79.07 T U . 1/10 1/100 73.4 + 5.67 1 79.07 **A7i: Column Addition** With Money £38.25 + £27.46 1 1 £65.71		**M7: Column Multiplication** H T U 1 4 7 x 4 1 2 5 8 8 Working towards more complex numbers **M9a: Long Multiplication** Column Th H T U 2 4 3 x 6 8 1 3 2 1 9 4 4 (8 x 243) + 1 2 1 1 4 5 8 0 (60 x 243) 1 6 5 2 4 1	division needs to have a real life problem solving context, The pupils **consider the meaning of the remainder and how to express it,** i.e. as a fraction, a decimal, or as a rounded number or value, depending upon the context of the word problem.
7	To be able to use their knowledge of place value to know how to add 1.234 to 4.1 To know how to add numbers of increasing complexity e.g. 81,059,3,668,15,301 and 20,551.	Decimal subtractions	Multiplying decimals with one decimal place either by grid or long multiplication column	This method relies heavily on times tables knowledge. It can be used to supply an answer with decimal places and it can be used to convert fractions to decimals.

	Line up the decimal points 22.3 + 34.1 56.4 Line up the decimal points 1.234 + 4.1 5.334 **MA3: Number Bonds** Year 6 24.25 + 31.63 + 21.75 = 77.63 46 31.63	**S11f: Column Subtraction** T U . 1/10 1/100 6 11 13 1 72.43 - 47.85 24.58	**M8e: Grid Method** Long Multiplication 7.38 x 6 = 44.28 x | 7 | 0.3 | 0.08 6 | 42 | 1.8 | 0.48 42 + 1.8 + 0.48 = 44.28 Being comfortable to do decimal adjustments 	**D10f: Short Division** Different Remainders 846 ÷ 5 169.2 5 | 8 3 4 6 . 1 0 169r1 5 | 8 3 4 6 169 1/5 5 | 8 3 4 6 **D10i: Short Division** 87.5 ÷ 7 = 12.5 12.5 7 | 1 8 3 7 . 5