Bedmond Academy

Mathematics Calculation Policy: Written Methods

Rationale

This policy outlines our academy's agreed progression through written strategies for: addition, subtraction, multiplication and division, in line with the new National Curriculum commencing September 2014. Through the policy, which begins in Year One and culminates in Year Six, we aim to link key manipulatives and representations in order that the children can be vertically accelerated through each strand of calculation. We know that school wide policies, such as this, can ensure consistency of approach, enabling children to progress stage by stage through models and representations they recognise from previous teaching, allowing for deeper conceptual understanding and fluency. As children move at the pace appropriate to them, teachers will be presenting strategies and equipment appropriate to children's level of understanding. However, it is expected that the majority of children in each class will be working at age-appropriate levels as set out in the National Curriculum 2014 and in line with school policy. Use of the progression and the teaching of strategies, which are appropriate for each child's age and ability, will be regularly monitored through planning scrutiny, work sampling and pupil interviews.

Aims of the Calculation Policy

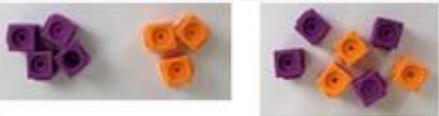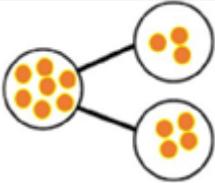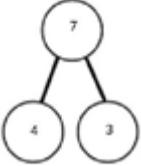The overall aim is that when children leave primary school they:
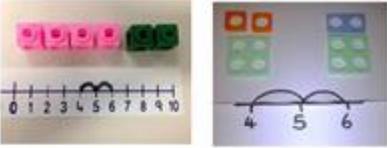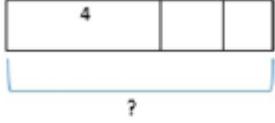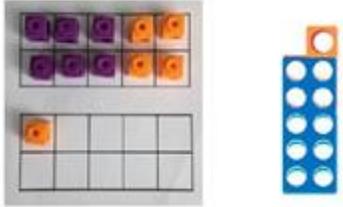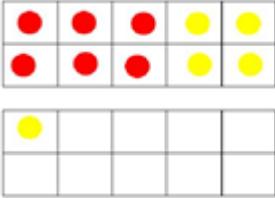
- Have a secure knowledge of number facts and a good understanding of the four operations;
- Are able to use this knowledge and understanding to carry out calculations mentally and to apply taught strategies when problem solving;
- Make use of diagrams and informal notes to help record steps and part answers when using mental methods that generate more information than can be kept in their heads;
- Have an efficient, reliable, compact written method of calculation for each operation that children can apply with confidence when undertaking calculations that they cannot carry out mentally; and
- Use a calculator effectively, using their mental skills to monitor the process, check the steps involved and decide if the numbers displayed make sense.

The importance of Mental Mathematics

Although this policy focuses on written calculations in mathematics, we recognise the importance of the mental strategies and known facts that form the basis of all calculations. Oral and mental work in mathematics is essential, particularly so in calculation. Early practical, oral and mental work must lay the foundations by providing children with a good understanding of how the four operations build on efficient counting strategies and a secure knowledge of place value and number facts. Later work must ensure that children recognise how the operations relate to one another and how the rules and laws of arithmetic are to be used and applied. Ongoing oral and mental work provides practice and consolidation of these ideas. The ability to calculate mentally forms the basis of all methods of calculation and has to be maintained and refined. A good knowledge of numbers is the product of structured practice and repetition. It requires an understanding of number patterns and relationships developed through directed enquiry, use of models and images (hundred square, number beads, number line) and the application of acquired number knowledge and skills. Secure mental calculation requires the ability to recall key number facts instantly.

Addition-

Key language which should be used: sum, total, parts and wholes, plus, add, altogether, more than, 'is equal to' 'is the same as'

	Conceptual	Pictorial	Abstract
Combining two parts to make a whole	Use other resources as well		$4 + 3 = 7$ (Four and three are parts and seven is the whole)
Start with the larger number and count on	Using cubes or Numicon	A bar model that encourages the children to count on.	An abstract number line. What is 2 more than 4?
Regroup to make 5 or 10	Use tens frames or numicon to partition numbers	Children can draw their own frames or use counters	$7 + 6 = 7 + 3 + 3 = 13$ Children to develop an early understanding of equality.

Add 2 digits to 1 digits using efficient methods	41 + 8 = Use base ten equipment to develop understanding of place value and partitioning	T O Use symbols to represent base ten equipment	41 + 8 1 + 8 = 9 40 + 9 = 49 $$\begin{array}{r} 4\ 1 \\ +\quad\ 8 \\ \hline 4\ 9 \end{array}$$
Add 2 digits to 2 digits using efficient methods	Begin without exchanging.	T O Tens Ones	Look out for ways to make ten. 36 + 25 = 30 + 20 = 50 1 5 5 + 5 = 10 50 + 10 + 1 = 61
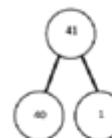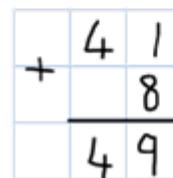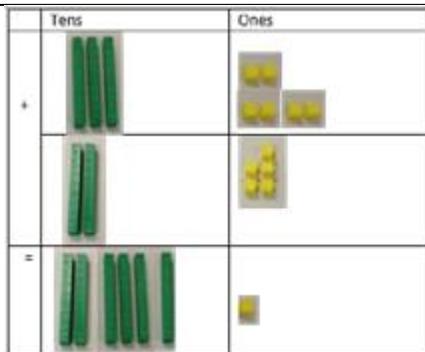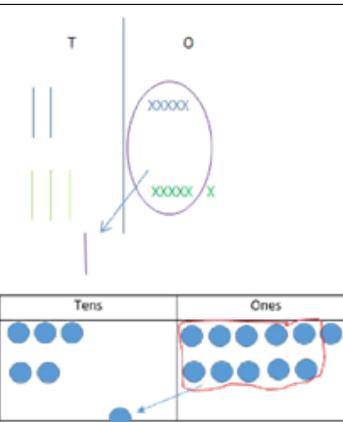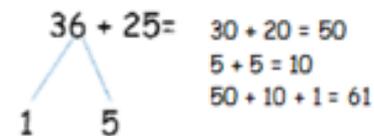
Larger numbers: Expanded and compressed	Using place value counters. **Remember to use place value counters when introducing decimals as well!**	Children to represent the counters e.g. like the image below If the children are completing a word problem, draw a bar model to represent what it's asking them to do | ?	
243	368		243 + 368 11 (3 + 8) 100 (40 + 60) 500 (200 + 300) 611 243 +368 6 11 1 1
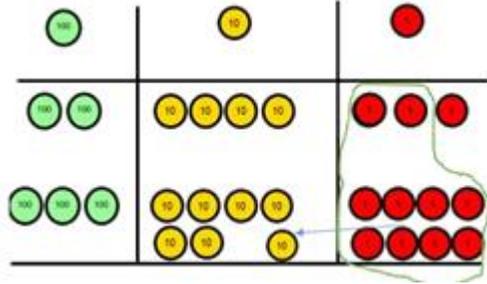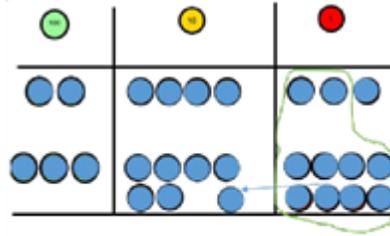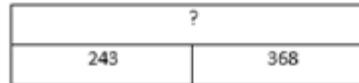
Fluency and Variation: Different ways to solve 21 + 34
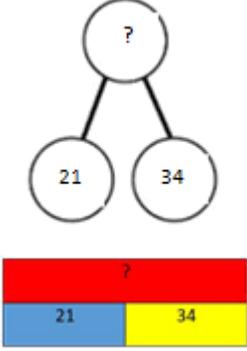
	Sam saved £21 one week and £34 another. How much did he save in total? 21+34=55. Prove it! (reasoning but the children need to be fluent in representing this)	$\begin{array}{r} 21 \\ +34 \\ \hline \end{array}$ 21 + 34 = ☐ = 21 + 34 What's the sum of 21 and 34? What other sums is it equivalent to?	 Always use missing digit problems too: | Tens	Ones
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◎ ◎	●
◎ ◎ ◎	?
?	4	
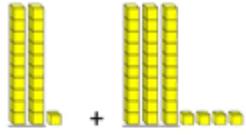
Subtraction-

Key language which should be used: take away, less than, the difference, subtract, minus, fewer, decrease, '7 take away 3, the difference is four'

Take away ones	4 − 3 = 1 Physically taking away or removing objects.	Use of the bar model: Children to either draw the pictures or the bar model and cross them out.	4 - 3 = __ = 4 - 3
Count back from a given number	6 − 2 Using number tracks or lines.	6 ? 2 Represent what they see pictorially.	4 6 Using blank number lines.
Finding the difference	? ? ? Comparing concrete resources.	XXXXXXXX XXXXX Use of the bar model ? Children to draw and compare	Find the difference between 8 and 6. Also explore why 9 - 7 = 8 - 6
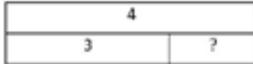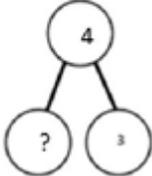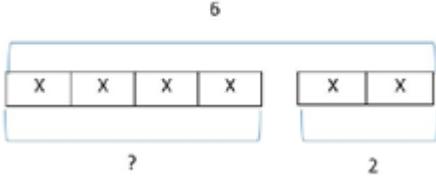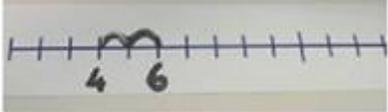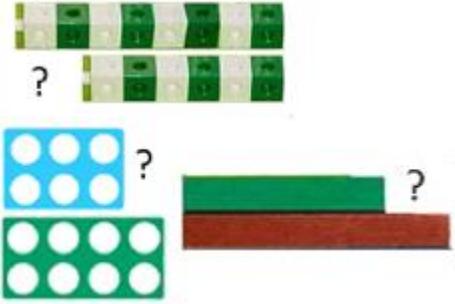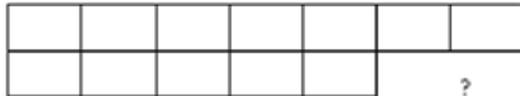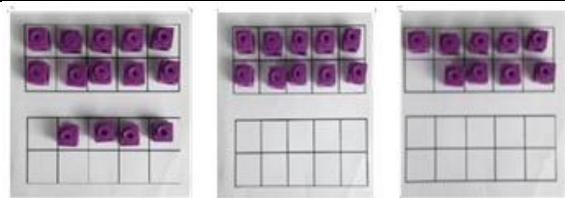
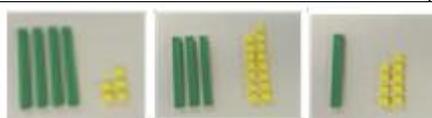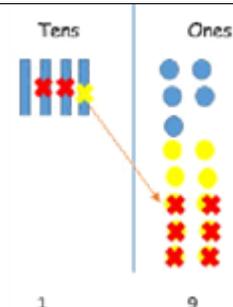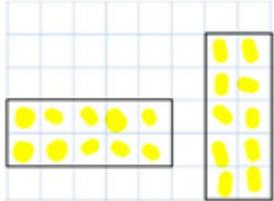|			
Make 5 and 10	14 - 5 Using Numicon or tens frames	14 - 5 = Children to draw their own tens frames.	14 − 5 = 9 You also want children to see related facts e.g. 15 − 9 = 5 Children to represent how they have solved it e.g. 14 - 5 = 9 14 is made up of 5, 5 and 4 so I can subtract one 5 to be left with 4 and 5 5 5 14 - 5 = 9 5 is made up of 4 and 1 so I can subtract 4 to make 10 and then 1 to get to 9 4 1
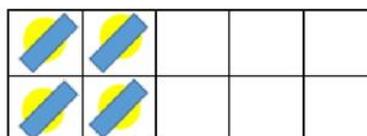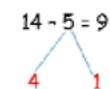
Subtract 1 and 2-digits from 2 digits: efficient methods	45-26
	1) Start by partitioning 45
	2) Exchange one ten for ten more ones
	3) Subtract the ones, then the tens.
	Start without exchanging.
		Tens Ones
		
		Represent base ten pictorially
			Expanded and compressed
			
			  45
			- 26
			   9 (15 - 6)
			+ 10 (30 - 20)
			  19

| Larger numbers	234 - 88 = **Remember to use place value counters when introducing decimals.**	Children to choose pictorial representations.	$$2\overset{2}{\cancel{3}}\overset{1}{4}$$ $$-\ \ 88$$ $$\overline{6}$$

Fluency and Variation: Different ways to solve 391 - 186 =
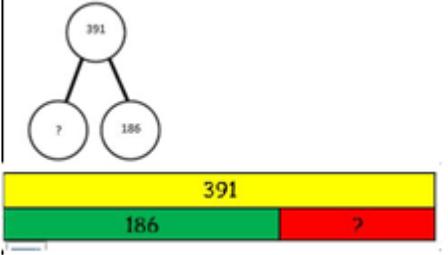
	Raj spent £391, Timmy spent £186. How much more did Raj spend? I had 391 metres to run. After 186 I stopped. How many metres do I have left to run?	$391 - 186$ $\boxed{}\ \ = 391 - 186$ 391 -186 $\overline{}$ What is the difference between 391 and 186?	What is the calculation? What is the answer? $3\ \ 9\ \ \boxed{}$ $-\ \boxed{}\boxed{}\ \ 6$ $\boxed{}\ \ 0\ \ 5$

# Multiplication-

Key language which should be used: double times, multiplied by, the product of, groups of, lots of, 'is equal to' 'is the same as'

Doubling, counting in multiples and repeated addition	Use a range of resources	XX XX XX XX XX XX Use of a bar model for a more structured method	$3 \times 4 = 3 + 3 + 3 + 3 = 4 + 4 + 4$
Arrays - helps to who commutativity	$2 \times 5 = 5 \times 2$	Children to draw their own arrays	$2 \times 5 = 10$ $5 \times 2 = 10$ $2 + 2 + 2 + 2 + 2 = 10$ $5 + 5 = 10$ $(2 \times 3) + (2 \times 2) = 10$
Partitioning and Grid Method	4×15	24×3 $\times 3$ 24 24 24	3 | 300 | 40 | 6 900 | 120 | 18 $= 1038$
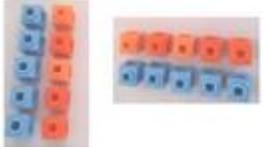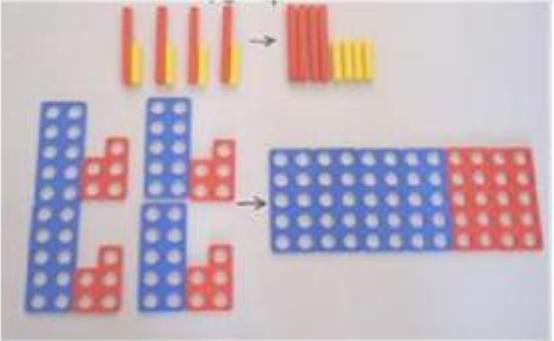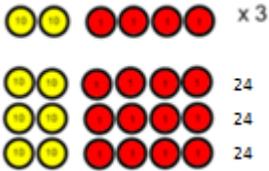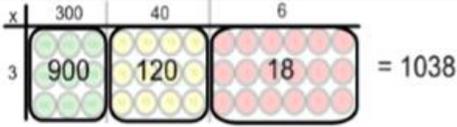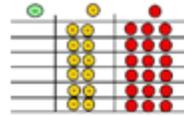
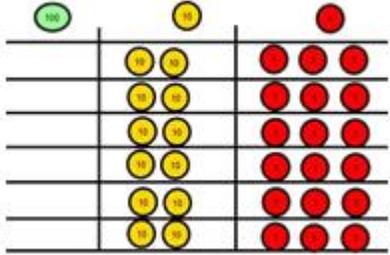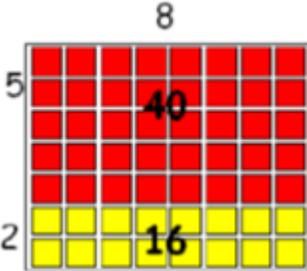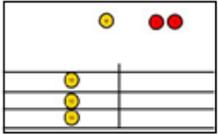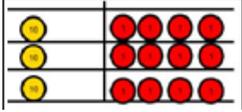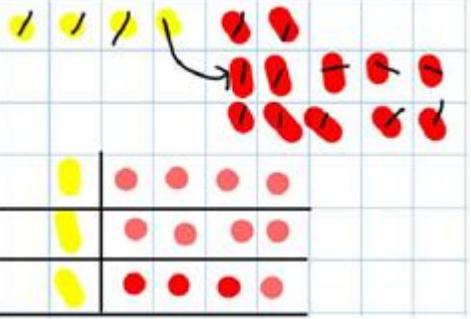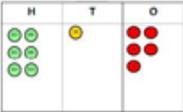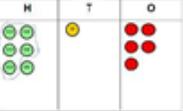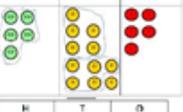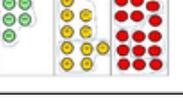| **Formal Column Method** | 6 x 23
 Step 1: get 6 lots of 23
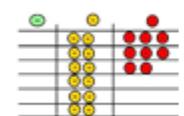
 Step 2: 6 x 3 is 18. Can I make an exchange? Yes! Ten ones for one ten….
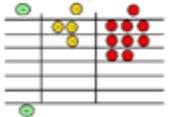
 Step 3: 6 x 2 tens and my extra ten is 13 tens. Can I make an exchange? Yes! Ten tens for one hundred…
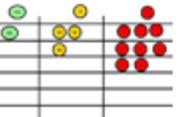
 Step 4 - what do I have I each column? | Hundreds \| Tens \| Ones
 1 \| \|
 3 \| 8 | 23 <br> x 6
 ___
 18 (6 x 3)
 120 (6 x 20)
 ___
 138

 6 x 23 =
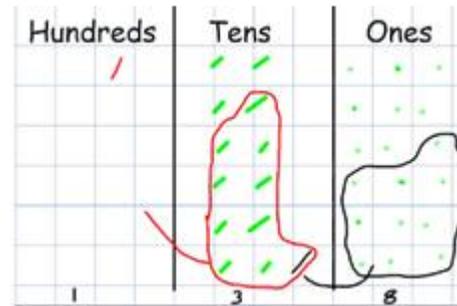
 $$\begin{array}{r} 23 \\ \times\ 6 \\ \hline 138 \\ {\scriptstyle 1\ 1} \end{array}$$

 $$\begin{array}{r} 1\ 2\ 4 \\ \times\quad 2\ 6 \\ \hline 7\ 4\ 4 \\ {\scriptstyle 1\quad 2} \\ 2\ 4\ 8\ 0 \\ \hline 3\ 2\ 2\ 4 \\ {\scriptstyle 1\quad 1} \end{array}$$

 Answer: 3224 |

Fluency and Variation: Different ways to solve 6 x 23

	Marie swims 23 lengths 6 times a week. How many lengths does she swim in a week? Tom saves 23p for 3 days each week. How much does he save in two week?	Find the product of 6 and 23. 6 x 23 = = 6 x 23 23 23 x 23 x 6 ___ ___	What is the calculation? What is the answer?
? With the counters, prove that 6 x 23 = 138 Why is 6 x 23 = 32 x 6?			

Division-

Key language which should be used: share, group, divide, divided by, half, 'is equal to' 'is the same as'

Sharing objects into groups	Using a range of concrete objects	This can also be done in a bar so all 4 operations have a similar structure: If the children are confident, they could also begin	What's the calculation?
Division as grouping or repeated subtracted	$6 \div 2$		
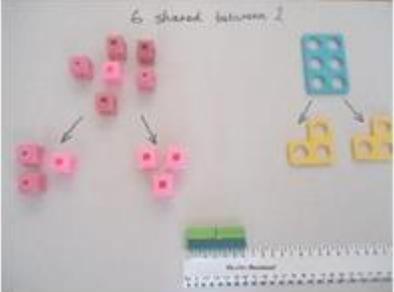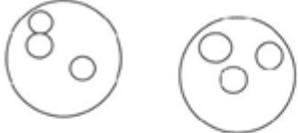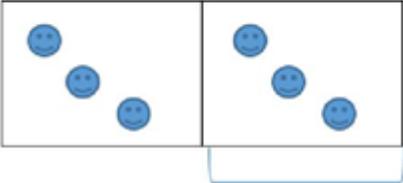
2 digits by 1 digit with remainders	13 ÷ 4 = 3 r 1 Use of lollipop sticks to form wholes Use of Cuisenaire rods and rulers (using repeated subtraction)		
Division as arrays - show	Using a range of resources 48 ÷ 6 = 8 48 ÷ 8 = 6	X X X X X X X X X X X X 6 rows of 2 12 ÷ 2 = 6 12 ÷ 6 = 2	56 ÷ 8 = 7
Chunking using place value counters	42 ÷ 3= 14 1. Make 42. Share the 4 tens between 3. Can we make an exchange with the extra 10? Exchange the ten for 10 ones and share out 12 ones		42 ÷ 3 42 = 30 + 12 30 ÷ 3 = 10 12 ÷ 3 = 4 10 + 4 = 14
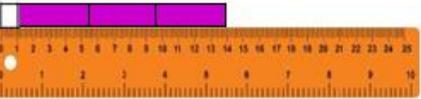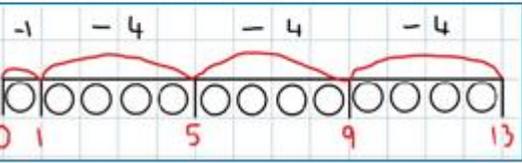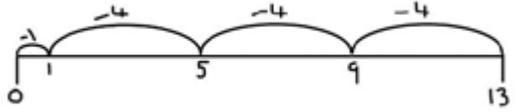
Bus stop method - remember to use place value counters again when introducing decimals	615 ÷ 5 Step 1: make 615 Step 2: Circle your groups of 5 Step 3: Exchange 1H for 10T and circle groups of 5 Step 4: exchange 1T for 10ones and circles groups of 5	Children to draw the place value counters until they are confident.	$$5 \overline{)6^11^15} = 123$$

Fluency and Variation: Different ways to solve 615 ÷ 5
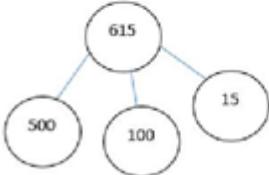
Using the part whole model below, how can you divide 615 by 5 without using the 'bus stop' method? 615 500 100 15	I have £615 and share it equally between 5 bank accounts. How much will be in each account? 615 pupils need to be put into 5 groups. How many will be in each group?	$5 \overline{)615}$ 615 ÷ 5 = ☐ = 615 ÷ 5 How many 5's go into 615?	What's the calculation? What's the answer? H T O