Calculation Policy

St Patrick's Catholic Voluntary Academy

Approved by:	Headteacher	**Date:** March 2024
Last reviewed on:	March 2023	
Next review due by:	March 2025	

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The following calculation policy has been devised to meet requirements of the National Curriculum 2014 for the teaching and learning of mathematics, and is also designed to give pupils a consistent and smooth progression of learning in calculations across the school. The policy is in line with methods used within White Rose Maths which is used to plan learning sequences. Please note that early learning in number and calculation in Reception follows the 'Development Matters' EYFS document, and this calculation policy is designed to build on progressively from the content and methods established in the Early Years Foundation Stage.

Age related expectations
The calculation policy is organised according to age related expectations as set out in the National Curriculum 2014. It is vital that interventions and appropriate scaffolding is in place to ensure all children can reach age related expectation. Children who are behind will receive immediate support to keep on track.

Providing a context for calculation
It is important that any type of calculation is given a real-life context or problem-solving approach to help build children's understanding of the purpose of calculation, and to help them recognise when to use certain operations and methods when faced with reasoning problems. This must be a priority within calculation lessons. Choosing a calculation method: Children need to be taught and encouraged to use the following processes in deciding what approach they will take to a calculation; to ensure they select the most appropriate method for the numbers involved.

Meeting Expectations in Foundation

Addition

Initial experiences should involve physical counting with a range of objects.
E.g.

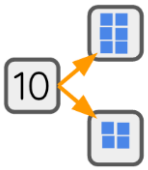
- Fingers
- Numicon
- Pegs
- Claps or drum beats
- Moveable objects

When children are confident at counting 2 groups of objects, they can begin counting on from a number to find the total.
This can be supported by putting objects in a container
*E.g. pennies in a purse **or** sweets in a bag*

Children may also count on using a physical number line.

Combining two groups to make a whole.

Children can fluently recall number bonds to 10.



E.g. Sue has 6p. Her Mum gives her 4p. How much does she have altogether? **or** Sue has 10p she spends 6p, how much does she have left? **or** Sue has 6p how much more does she need to make 10p altogether?

Number bonds can be shown as simple number sentences
e.g. 10p = 6p + 4p
20p = 15p + 5p
Use the partitioning diagram
as shown above to move into the abstract.

4 + 3 = 7
10 = 6 + 4

Children can add two single digits where the answer is up to 18.

Subtraction

Initial experiences should involve physical and oral counting backwards with a range of objects and real life situations.
E.g. fingers, Numicon, pegs, coins, moveable objects and songs.

Subtraction as taking away
Knowledge of 1 more and 1 less.
Use tins and counters.
E.g. If we had 8 biscuits and we ate one, how many would be left?

Use Numicon. E.g. You have five. Take away one. What do you have left?

Use washing line and spotty cards.
E.g. Find a card with one spot and peg it on the line. Find a card with one more spot etc.

Use physical number lines
E.g. give children a number from 1-10 and ask them to line up in order.

Use song and rhyme to count back. e.g. 10 speckled frogs.

Understanding of the difference
Use washing line or number track to count on, e.g. from 6 to 8

To find the difference between 4 and 7, make lines of each number and count on from the smaller number.
What's the difference between 7 and 4?

Start on a number and find one more and one less.

Multiplication

Begin to lay the foundations for multiplying by maximising opportunities when counting.

Counting forwards and backwards in 2s
Number rhymes such as two, four, six, eight, ten fat sausages sizzling in a pan.
Count up in 2s to put sausages in the pan.

Count back when sausages go bang & pop

Counting in pairs
pairs of children, socks, animal legs, eggs in an egg box.

How many wheels do we need to make three cars?

How many wheels to make 6 bikes.

Division

Sharing: Requires secure counting skills
Develops importance of one-to-one correspondence

Practical activities involving sharing, distributing cards when playing a game, putting objects onto plates, into cups, hoops etc.

Number rhymes counting in 2s,

Grouping
Sorting objects into 2's / 3's/ 4's etc.
How many pairs of socks are there?

There are 10 flower seeds. Plant 2 in each pot. How many pots are needed?
Link to table facts: 2, 4, 6, 8, 10.

Tim has 12 Lego wheels. How many cars can she make?

Meeting Expectations in Year 1

Addition

Children should continue to use physical objects for counting and combining initially.

Children need to understand the concept of equality before using the '=' sign. Calculations should be written either side of the equality sign so that the sign is not just interpreted as 'the answer'.

2 = 1 + 1
2 + 3 = 4 + 1
3 = 3
2 + 2 + 2 = 4 + 2

Missing numbers need to be placed in all possible places.

3 + 4 = ▶ ▶= 3 + 4
3 + ▶ = 7 7 = ▶ + 4
▶ + 4 = 7 7 = 3 + ▶
☐ + ▶ = 7 7 = ▶ + ☐

Children should have access to a wide range of counting equipment. Numicon, number lines, 100 squares, counters, beads

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Draw jumps on numbered number lines to support understanding of the mental method

Children can create their own jumps using rulers, fingers, pens, bodies etc.

7 + 4

Use the vocabulary related to addition and symbols to describe and record addition number sentences
Recording by
- drawing jumps on prepared lines
- constructing own lines
- Using a 100 square

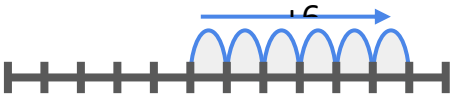
Subtraction

Number sentences and missing number

7 - 3 = ▶ ▶ = 7 - 3
7 - ▶ = 4 4 = ▶ - 3
▶ - 3 = 4 4 = 7 - ▶
☐ - ▶ = 4 4 = 7 - ▶

Understand subtraction as 'take away'
E.g. 6 – 1 = 5

Find a 'difference' by counting up;
I have saved 5p. The socks that I want to buy cost 11p. How much more do I need in order to buy the socks?



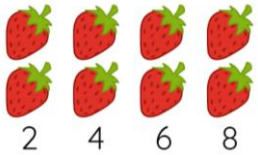
5p + ☐ = 11p
Use practical and informal written methods to support the subtraction

I have 11 toy cars. There are 5 cars too many to fit in the garage. How many cars fit in the garage?

Use the vocabulary related to subtraction and symbols to describe and record subtraction number sentences
Recording by
- drawing jumps on prepared lines
- constructing own lines
- Using a 100 square

Multiplication

Multiplication is related to doubling and counting groups of the same size.



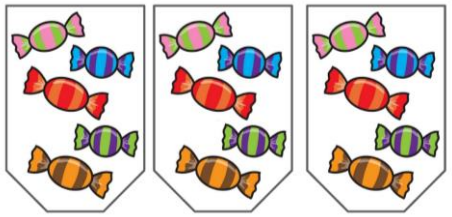
From the above pictorial representation:

Looking at columns	Looking at rows
2 + 2 + 2 + 2	4 + 4
4 groups of 2	2 groups of 4

Counting using a variety of practical resources

Counting in 2s
e.g. counting socks, shoes, animal legs…
Counting in 5s
e.g. counting fingers, fingers in gloves, toes…
Counting in 10s
e.g. fingers, toes…

Pictures / mark making
There are 5 sweets in one bag.
How many sweets are there in 3 bags?



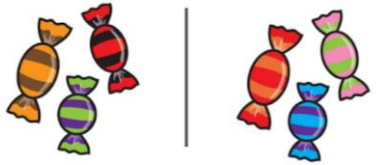
Division

Once children are confident at sharing objects practically they can be encouraged to make simple jottings.

Initially this could be using physical objects but requiring children to draw the correct number of circles to share between.

Next children should be encouraged to make simple drawings to help solve their problems.
Checking by counting that all groups are the same.

E.g.
Sharing – 6 sweets are shared between 2 people. How many do they have each?



12 pound coins are shared between 4 people. How many do they have each?

The number sentence can be modelled alongside. E.g. 12 ÷ 4 = 3

Children use physical objects > simple drawings > circle representations

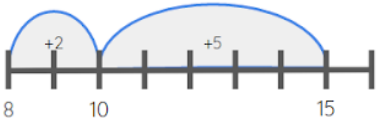
Meeting Expectations in Year 2

Addition

Continue using a range of equations but with appropriate, larger numbers. E.g. 13 + 4 = ∇
Children also need to be confident in bridging through 10.

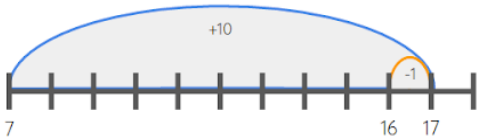
Partition into tens and ones and recombine as a mental strategy. E.g.
15 + 13 =
10 + 10 =20
5 + 3 = 8
20 + 8 = 28

Children should be able to partition the 7 to relate adding the 2 and then the 5. Look for practical use of number bonds.
8 + 7 =



Number lines are a good visual model of this.

Add 9 or 11 by adding 10 and adjusting.
Begin to add 19 or 21.
7 + 9 =



Children begin to use blank number lines

Column addition can be taught when place value is secure. Children are not required to exchange using this method yet.

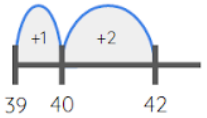
	2	3
+	1	4
	3	7

	3	2
+	2	4
	5	6

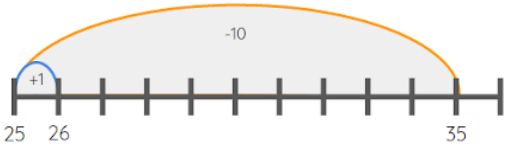
Subtraction

Continue using a range of equations as at year 1 but with appropriate numbers.
E.g. extend to 14 + 5 = 20 - ∇

Find a small difference by counting up
42 – 39 = 3

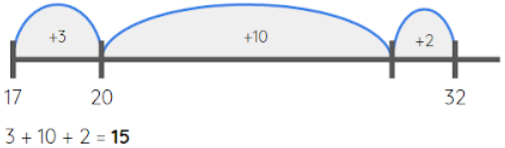


Subtract 9 or 11 by adding 10 and adjusting.
Begin to subtract 19 or 21
35 – 9 = 26



Use known number facts and place value to subtract
Use a number line to count up from the smallest number to find the difference.

Bridge through 10 where necessary.
E.g. 32 – 17 = 15



3 + 10 + 2 = **15**

Children begin to use blank number lines

Column subtraction to be used when place value secure without exchanges.

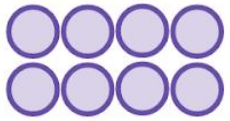
	4	8
-	2	3
	2	5

Multiplication

Missing numbers need to be placed in all possible places.

7 x 2 = ▶	▶ = 2 x 7
7 x ▶ = 14	14 = ▶ x 7
▶ x 2 = 14	14 = 2 x ▶
☐ x ▶ = 14	14 = ▶ x ☐

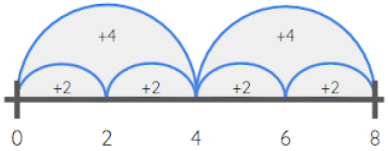
Arrays and repeated addition
An array



2 x 4
4 + 4

4 x 2
2 + 2 + 2 + 2

Repeated addition



Doubling multiples of 5 up to 50
15 x 2 = 30

Partition two digit numbers into tens and ones to multiply.
13 x 3 =
10 x 3 = 30
3 x 3 = 9
30 + 9 = 39

Use doubling to multiply by 2.

15 x 2 = **30**
10 + 5
20 + 10 = **30**

Division

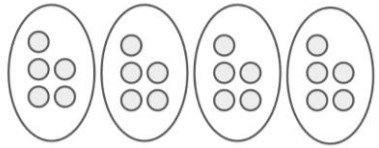
Use multiplication facts to solve missing number problems.

6 ÷ 2 = ▶	▶ = 6 ÷ 2
6 ÷ ▶ = 3	3 = 6 ÷ ▶

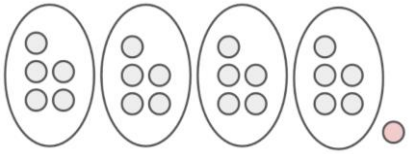
Grouping
12 children get into teams of 4 to play a game. How many teams are there?

When children are confident in the process of sharing, simplify drawings to jottings, checking that all groups are the same. E.g.
There are 6 strawberries.
How many people can have 2 each?

There are 20 sweets and 4 friends share them between themselves. How many do they get each?



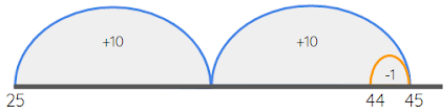
Children also need to be taught that if they are not all equal the extra ones must be left as a remainder. E.g.
21 ÷ 5 = 4 r1



Meeting Expectations in Year 3

Addition

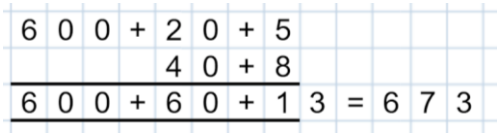
Add 9, 19, 29 or 11, 21, 31 by adding 10s and adjusting. E.g.
25 + 19 = 44



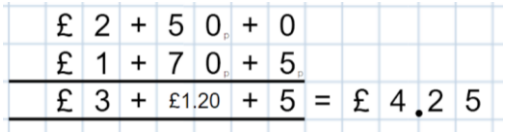
Partition using known number facts and doubling. E.g.

25 + 78 = 103	38 + 35 = 73
(25+75) + 3	(Double 35) + 3
100 + 3 = 103	

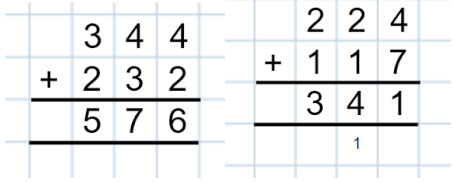
Expanded addition
625 + 48



Add decimals in the context of money.
£2.50 + £1.75



Formal column addition extended to bridging 10



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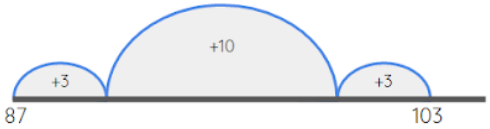
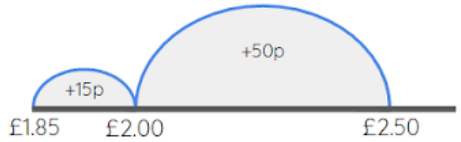
Subtraction

Use counting on to find the difference for most subtractions using number lines
103 – 87 = 16



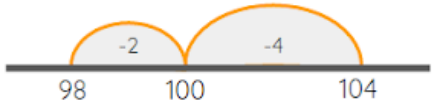
3 + 10 + 3 = 16

Subtract decimals in the context of money.
£2.50 - £1.85 = 65p



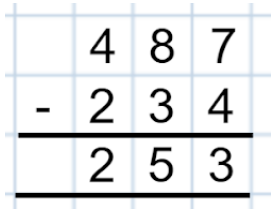
15p + 50p = 65p

Count back when subtracting a small number from a large number.
104 - 6 = 98



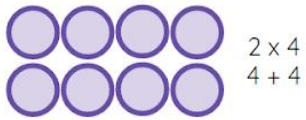
Bridge through 100s and 10s as appropriate.

Formal column subtraction moving into simple exchanges between columns.



Multiplication

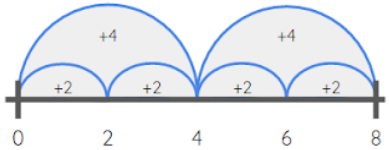
Arrays and repeated addition
An array



2 x 4
4 + 4

4 x 2
2 + 2 + 2 + 2

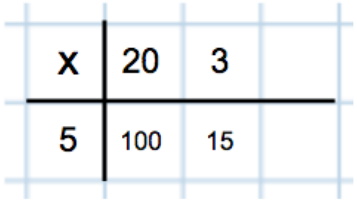
Repeated addition



Doubling multiples of 5 up to 50
15 x 2 = 30

Multiply 2 digit numbers by 2, 3, 4 or 5, by partitioning into tens and units. E.g.
23 x 3 = 69
20 x 3 = 60
3 x 3 = 9

Grid method to multiply TU x U
23 x 5 = 115



100 + 15 = 115

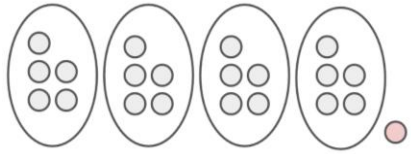
Division

Count in groups.
How many 5s in 15?

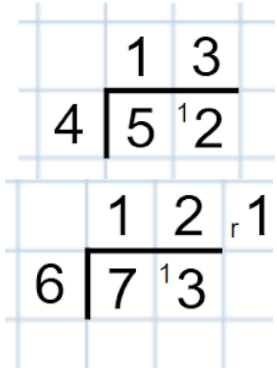
1 x 5 = 5
2 x 5 = 10
3 x 5 = 15

15 ÷ 5 = 3
15 ÷ 3 = 5

Ensure children are secure with grouping. Children also need to be taught that if groups are not all equal the extra ones must be left as a remainder. E.g.
21 ÷ 5 = 4 r1



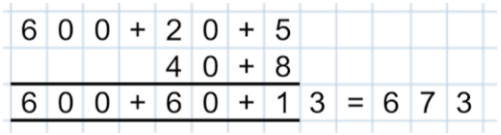
Use short division to divide TU by U with remainders.
52 ÷ 4 = 13



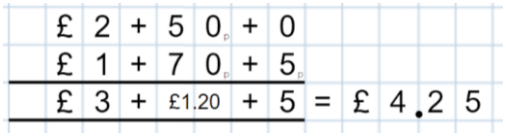
Meeting Expectations in Year 4

Addition

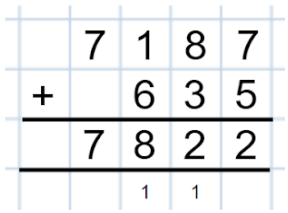
Expanded Addition
625 + 48



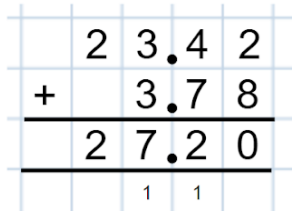
Add in context of money to 2 decimal places.
£2.50 + £1.75



Formal column addition with numbers to 1000.



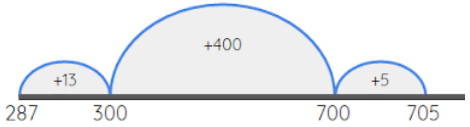
Add numbers up to 2 decimal places in context of measures.



Continue to use number line when working with time & temperature. E.g. A TV show starts at 9:35 and lasts 1 hour 35 minutes. What time does it end?

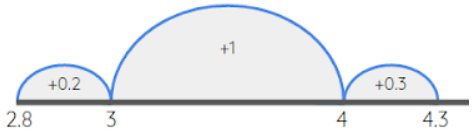
Subtraction

Number lines to support 'counting on' method to larger numbers. E.g.
705-287 = 418



13 + 400 + 5 = 418

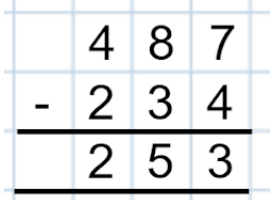
Extend to decimals to 1 decimal place. E.g.
4.3 – 2.8 = 1.5



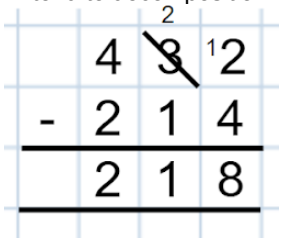
0.2 + 1 + 0.3 = 1.5

Subtract decimals in context of money.
See Year 3 example.

Formal column subtraction
Begin without decomposition.



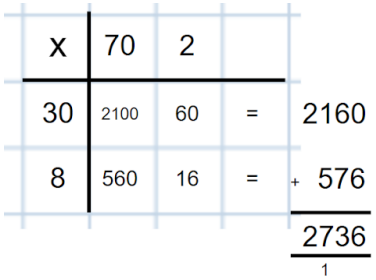
Extend to decomposition where appropriate.



Continue to use number line when working with time.

Multiplication

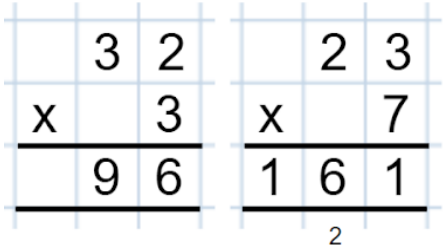
Extend grid method to include HTU x U and TU x TU E.g.
246 x 8 and 72 x 38



Approximate by rounding first: E.g.
223 x 8 to 200 x 8 = 1600
72 x 38 to 70 x 40 = 2800

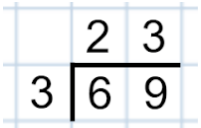
Multiply decimals to 1 decimal place using grid method.

Formal short multiplication

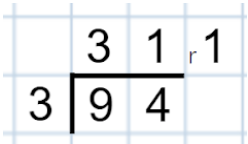


Division

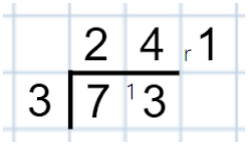
Short Division
69 ÷ 3 = 23



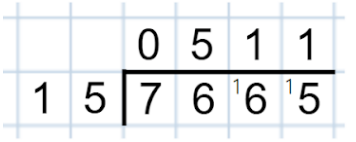
Short Division with end remainders
94 ÷ 3 = 31 r1



Short Division with internal remainders
73 ÷ 3 = 24 r1



Extend to ThHTU ÷ TU
3665 ÷ 15 = 511



1 x 15 = 15
2 x 15 = 30
3 x 15 = 45
4 x 15 = 60
5 x 15 = 75

Children may write out the multiplication tables of the divisor.

Meeting Expectations in Year 5

Addition

Use mental methods where possible to add.

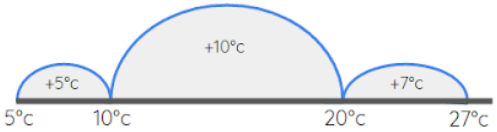
Continue to use column addition up to ThHTU. Add several numbers with different numbers of digits. E.g.
Find the total of 442, 1786, 25

	1	7	8	6
		4	4	2
+			2	5
	2	2	5	3
	1	1	1	

Add decimals with different numbers of digits with either 1 or 2 decimal places. Decimals must line up. E.g.
14.75 + 12.8 = 27.55

	1	4	.	7	5
+	1	2	.	8	
	2	7	.	5	5
		1			

Continue to use number line when working with time & temperature. E.g. The average temperature in March is 5°c and in July it is 27°c. What is the difference between the two?
27 - 5 = 22



5°c + 10°c + 7°c = 22°c

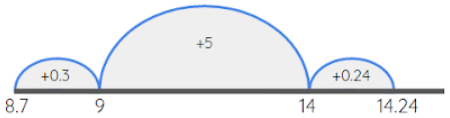
Extend to negative numbers.
See Year 4 for example of time.

Subtraction

Formal column subtraction with decomposition.

		2		
	4	~~3~~	12	
-	2	1	4	
	2	1	8	

Number line to support counting on with decimals with different numbers of digits with either 1 or 2 decimal places. E.g.
14.24 – 8.7 = 5.54



0.3 + 5 + 0.24 = 5.54

Move to formal column subtraction E.g.
14.24 – 8.7 = 5.54

		0	13		
		~~1~~	~~4~~	12	4
-			8	.	7
			5	.	5	4

Use formal methods to subtract ThHTU from ThHTU.

Use formal methods to subtract decimals from decimals with up to 2 decimal places.

Use formal methods where numbers include multiple zeros. E.g.
2000 - 1542 = £20.00 - £12.65=

Continue to use number line when working with time & temperature.

Multiplication

Multiply two multiples of 10 fluently. E.g.
30 x 60 = 1800
20 x 60 = 1200

Multiply whole numbers and decimals by 10, 100 and 1000 fluently. E.g.
23 x 100 =
45 x 10 =
3.6 x 100 =
3.87 x 1000 =

Formal short multiplication

		3	2				2	3
x			3		x			7
		9	6			1	6	1
							2	

Formal long multiplication

			1			
			7	2		
		x	3	~~8~~		
		5	7	6		
+	2	1	6	0		
	2	7	3	6		
		1				

Children can cross out numbers they have used to avoid confusion. When multiplying, carry at the top but when adding, carry at the bottom.

Division

Short Division with internal remainders
73 ÷ 3 = 24 r1

		2	4	r1
3	7	1	3	

Divide decimal numbers where some questions are in a worded context. E.g.
5 cleaners earn £350.50 in one day. How much does one cleaner earn in one day?
350.50 ÷ 5

		0	7	0	.	1	0
5	3	3	5	0	.	5	0

E.g.
We have 7.59kg of cookies. A small bag of cookies weighs 0.36kg. How many bags of cookies can we fill?
7.59 ÷ 0.36 =

Always make the <u>divisor</u> into a whole number by using a multiple of 10 e.g. 10, 100, 1000. Whole numbers are easier to divide by.
0.36 x 100 = 36
Adjust the numerator by multiplying using the same multiple of 10.
7.59 x 100 = 759
Now calculate
759 ÷ 36 = 21 r3

		0	2	1	r3
3	6	7	5	9	

1 x 36 = 36
2 x 36 = 72
3 x 36 = 108

Use rounding remainders appropriately. We can only fill 21 bags.

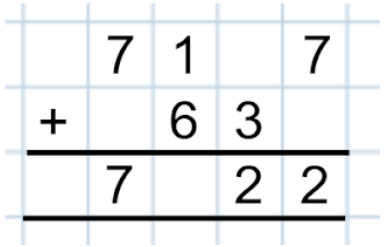
Meeting Expectations in Year 6

Addition

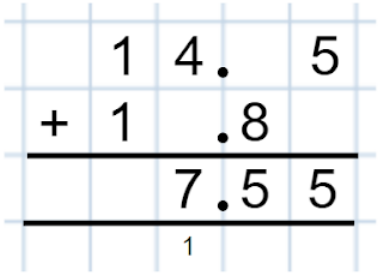
Add numbers up to 10,000,000 and decimals with different numbers of digits with up to three decimal places. E.g.
564,765 + 265,876 =
12.765 + 126.4 =

Begin to add numbers including negatives, always in context. E.g.
-5°c + 9°c =
-9°c + 15°c =

Reason with formal written method using missing numbers.



Including decimals.



Continue to use number line when working with time & temperature.

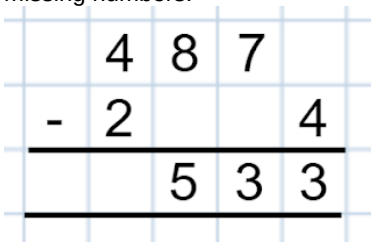
See Years 3 and 4 for examples.

Subtraction

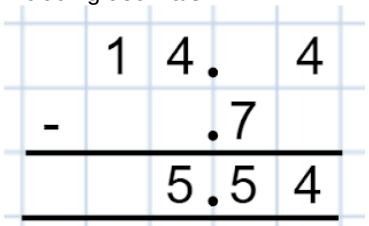
Subtract numbers up to 10,000,000 and decimals with different numbers of digits with up to three decimal places. E.g.
564,765 - 265,876 =
212.765 - 126.4 =

Begin to subtract numbers including negatives, always in context. E.g.
5°c - 9°c =
9°c - 15°c =

Reason with formal written method using missing numbers.



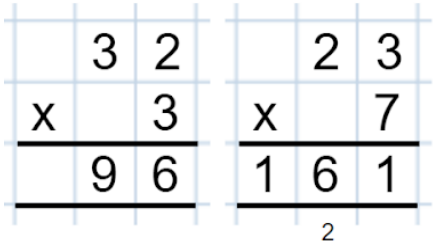
Including decimals.



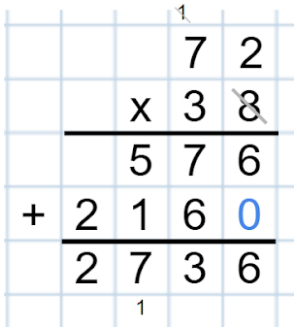
Continue to use number line when working with time & temperature.

Multiplication

Formal short multiplication

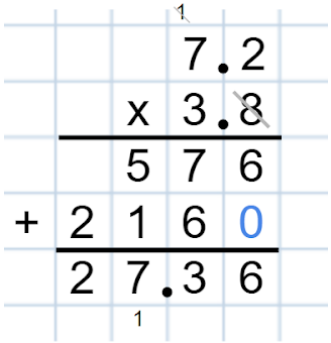


Formal long multiplication



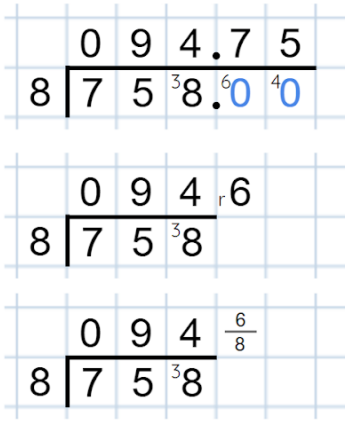
Children can cross out numbers they have used to avoid confusion. When multiplying, carry at the top but when adding, carry at the bottom.

Multiplying Decimals
Multiply decimals by decimals and whole numbers.

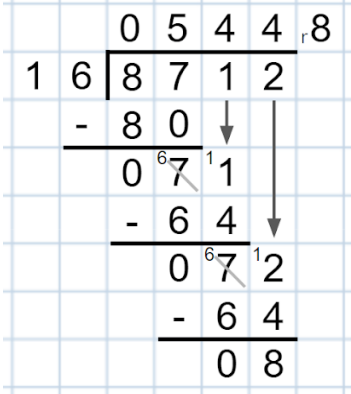


Division

Formal short division with remainders represented as fractions and decimals.



Formal long division with remainders represented as fractions and decimals.



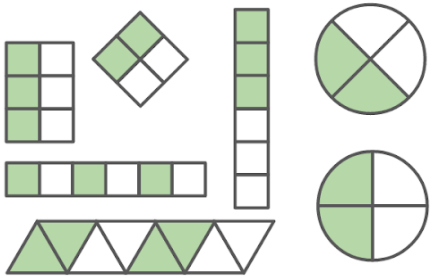
1 x 16 = 16
2 x 16 = 32
3 x 16 = 48
4 x 16 = 64
5 x 16 = 80

8712 ÷ 16 = 544 r8 **or** 544 ½ **or** 544.5

Fractions Years 2 - 5

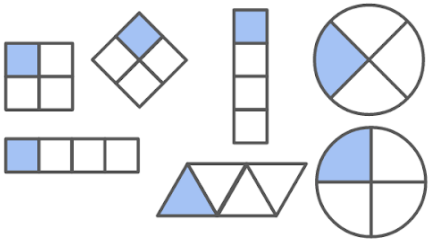
Meeting Expectation in Year 2

Identify one half of a shape given in a range of pictorial representations.

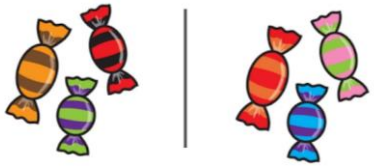


½ means one out of every 2.

Identify one quarter of a shape given in a range of pictorial representations.



Halve a set of objects or amount of money by sharing.



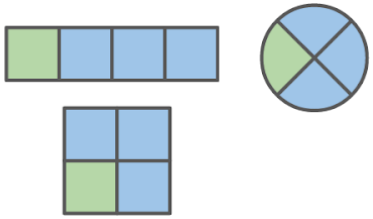
Share this money between 2 children. How much do they get each?

Meeting Expectation in Year 3

Adding fractions with common denominators

Identify what must be added to a fraction to make 1 whole one. E.g.

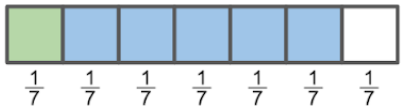
$$\frac{1}{4} + \frac{3}{4} = \frac{4}{4} = 1$$



One whole on is where the numerator and denominator are the same.

Extend to the addition of fractions with the same denominator, not bridging the whole.

$$\frac{1}{7} + \frac{5}{7} = \frac{6}{7}$$



When denominators are the same, we can simply add the numerators.

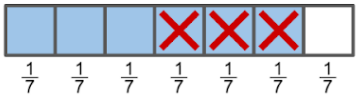
Meeting Expectation in Year 4

Adding fractions with common denominators

Continue to practice addition of fractions with the same denominator.

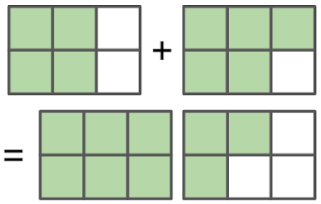
Subtracting fractions with the same denominator.

$$\frac{6}{7} - \frac{3}{7} = \frac{3}{7}$$



Adding fractions when the whole is bridged,

$$\frac{4}{6} + \frac{5}{6} = \frac{9}{6}$$



Finding fractions of quantities. E.g.

$$\frac{2}{5} \text{ of } 10 = 4$$

$10 \div 5 = 2$

$2 \times 2 = 4$

Rule: Divide by the denominator then multiply by the numerator. Divide by the bottom then times by the top.

Use models and images to support. Use concrete objects to begin then move to pictorial and abstract.

Meeting Expectation in Year 5

Adding and subtracting fractions with common denominators

See Year 4 to add and subtract fractions with common denominators. Give answers as mixed numbers. E.g.

$$\frac{4}{6} + \frac{5}{6} = \frac{9}{6} = 1\frac{3}{6}$$

6 into 9 goes 1 remainder 3

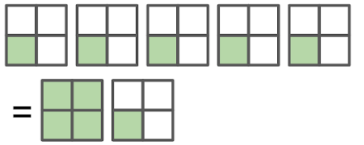
Extend to add and subtract fractions with different denominators, including simplification.

$$\frac{2}{3}\,{}^{\times 3} + \frac{5}{9} =$$

$$\frac{6}{9} + \frac{5}{9} = \frac{11}{9} = 1\frac{2}{9}$$

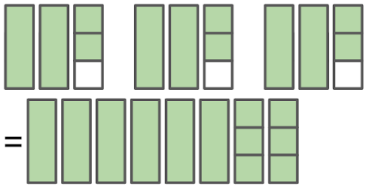
Multiply a single fraction by a whole number

$$5 \times \frac{1}{4} = \frac{5}{4} = 1\frac{1}{4}$$



Multiply a mixed number by a whole number. Begin with a pictorial methods.

$$3 \times 2\frac{2}{3} = 6\frac{6}{3} = 8$$



Extend to a formal written method.

Fractions Year 6

Addition

Formal written methods for addition.
Find common denominators using table facts and common multiples.
Here, 28 is a common multiple of 4 and 7.

$$\frac{3}{4}\ ^{\times 7} + \frac{2}{7}\ ^{\times 4} =$$

$$\frac{21}{28} + \frac{8}{28} = \frac{29}{28} = 1\frac{1}{28}$$

Extend to the addition of mixed numbers.
Convert mixed numbers to improper fractions before addition.

$$1\frac{1}{4} + \frac{2}{7} =$$

$$\frac{5}{4}\ ^{\times 7} + \frac{2}{7}\ ^{\times 4} =$$

$$\frac{35}{28} + \frac{8}{28} = \frac{43}{28} = 1\frac{15}{28}$$

Always give answers in their lowest form by finding common factors of numerator and denominators.

$$\frac{4}{12} = \frac{2}{6} = \frac{1}{3}$$

Numerator and denominator can be halved.

2s go into 2 and 6.

Subtraction

Formal written methods for subtraction.
Find common denominators using table facts and common multiples.

$$\frac{3}{4}\ ^{\times 7} - \frac{2}{7}\ ^{\times 4} =$$

$$\frac{21}{28} - \frac{8}{28} = \frac{13}{28}$$

Notice here, 13 is a prime number and so this fraction cannot be simplified.

Extend to the addition of mixed numbers.
Convert mixed numbers to improper fractions before subtraction.

$$1\frac{1}{4} - \frac{2}{7} =$$

$$\frac{5}{4}\ ^{\times 7} - \frac{2}{7}\ ^{\times 4} =$$

$$\frac{35}{28} - \frac{8}{28} = \frac{27}{28}$$

Always give answers in their lowest form by finding common factors of numerator and denominators.

$$\frac{4}{12} = \frac{2}{6} = \frac{1}{3}$$

Numerator and denominator can be halved.

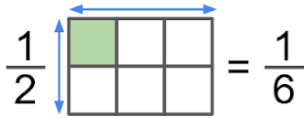
2s go into 2 and 6.

Multiplication

Multiplying single fraction by whole number.

Multiply two proper fractions.
Begin with a pictorial method. E.g.

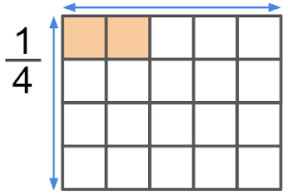
$$\frac{1}{3} \qquad \frac{1}{3} \times \frac{1}{2} = \frac{1}{6}$$



$$= \frac{1}{6}$$

E.g.

$$\frac{2}{5} \qquad \frac{2}{5} \times \frac{1}{4} = \frac{2}{20} = \frac{1}{10}$$



$$= \frac{2}{20} = \frac{1}{10}$$

Once the pupils are confident, extend to a formal written method. E.g.

$$\frac{2}{5} \times \frac{1}{4} = \frac{2 \times 1}{5 \times 4} = \frac{2}{20} = \frac{1}{10}$$

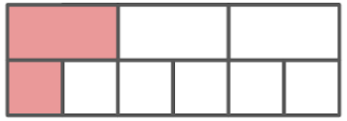
E.g.

$$\frac{1}{3} \times \frac{1}{2} = \frac{1 \times 1}{3 \times 2} = \frac{1}{6}$$

Division

Dividing proper fractions by whole numbers
E.g.

$$\frac{1}{3} \div 2 = \frac{1}{6}$$



Children must understand that dividing by a whole number is the same as multiplying by the ***reciprocal***. E.g.

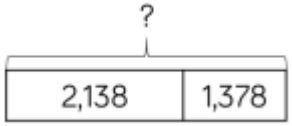
$$\frac{1}{3} \div 2 = \frac{1}{3} \times \frac{1}{2} = \frac{1}{6}$$

Visual representations of calculations to support written methods

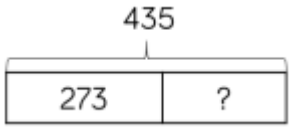
Bar models

Bar models are a visual representation of a written method. They are used to represent all the calculations and can be used with fractions, decimals and percentages. Bars are drawn and then used to combine numbers together or find missing amounts.

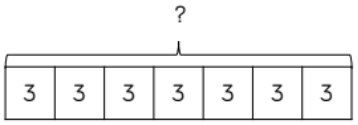
Addition
2,138 + 1,378 =



Subtraction
435 - 273 =

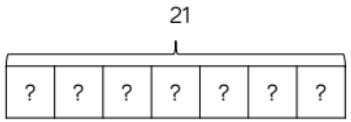


Multiplication



$3 \times 7 = 21$
$7 \times 3 = 21$

Division

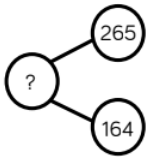


$21 \div 7 = 3$

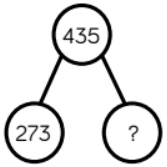
Part, part, whole models

Part, part, whole models are used within addition and subtraction to highlight the link between place value and calculation.

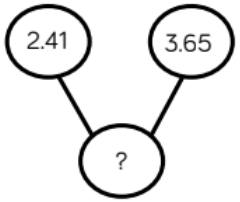
When the parts are complete and the whole is empty, children use aggregation (bringing parts together) to add the parts to find the total.



When the whole is complete and at least one of the parts is empty, children use subtraction through partitioning to find the missing part.



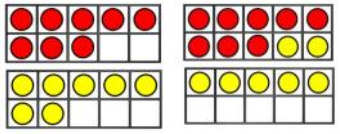
In upper Key Stage 2, children can use part, part whole models to add and subtract with decimals, percentages and fractions where required.



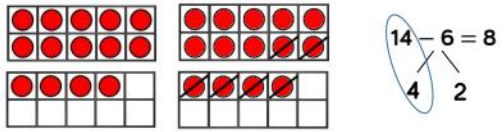
Ten Frames

Tens frames are a visual representation to allow children to see calculations within ten and to see exchanges.

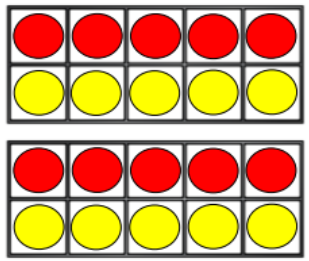
Addition of numbers allows children to see which parts of numbers can go together to make whole tens.



Subtraction can be demonstrated by children removing counters from the tens frame and by partitioning to support mental calculation.



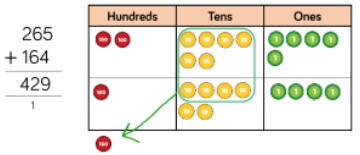
Tens frames are also used within Key stage 1 to look at patterns within early times tables, multiplication and division problems by looking at simple groups and patterns within numbers.



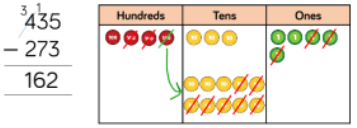
Place value counters

To support children writing out calculation, place value grids and counters are used to support clarity in exchanges between the columns and to visualise calculation processes.

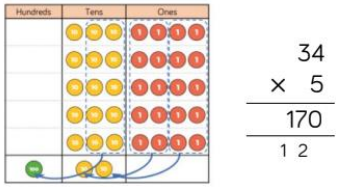
Addition - physical counters are used to support images used.



Subtraction - In subtraction grids can be shown in removing counters whilst also exchanging between columns

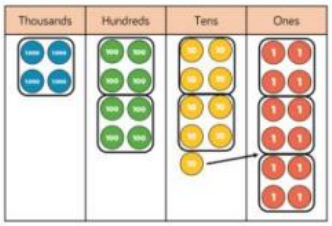


Multiplication - Place value counters can be used to support the understanding of column multiplication, showing exchanges



$$\begin{array}{r} 34 \\ \times\ 5 \\ \hline 170 \\ \hline 1\ 2 \end{array}$$

Division - counters within columns are used for grouping in division.



$$4\overline{)4892^{1}} = 1223$$

BIG question starters for reasoning opportunities

BIG question starters to create reasoning opportunities . . .

What is the same / different about . . .

Which of these numbers/calculations are trickier? Why?

Do you agree or disagree that . . .

Is it always/sometimes/never true that . . .

What do you notice about . . .

Give me an example of . . . and another . . .

Spot the mistake . . . explain the mistake

What couldn't it be? What could it be?

Give me a silly suggestion for . . .

Convince me that . . .

Prove by drawing/using dienes/using algebra that . . .

What comes next . . . What came before?

The answer is . . ., what's the question?

What's in the empty box?

If we know . . . what else do we know?

Spot the pattern, explain the pattern.

Find an equivalent for . . .

Can I change the order I do this in?

Can you make up a story/real situation for this maths?

Question to check understanding . . .

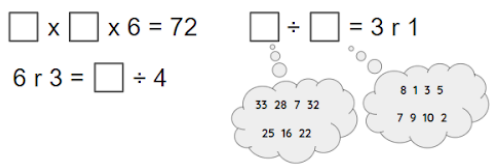
Can you explain how you know that?

Why must that be the correct answer?

How do you know that?

Are you sure you're correct?

What's in the empty box?



It must be this because…
It can't be that because…
I know that … so …

If there's anything better than one empty box, it's two! This opens up children to multiple possibilities so that there's not just one right answer

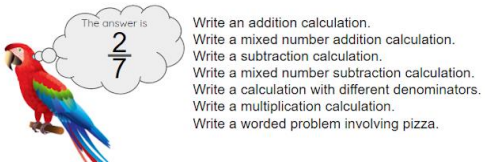
Give me an example of . . . and another . . .

A common factor of 66 and 24
A multiple of 3 over 200 (using the rule that multiples of 3 have digits that add to 3, 6 or 9)
A multiple of 6 over 1000 (using the rule that multiples of 6 must be even multiples of 3)

36 is a multiple of 3 because 3+6=9.
So, 360 is a multiple of 3. Why?
What about **213**?

Use what you know to write a multiple of 6 greater than 1000 ending in a 2.
e.g. 4302

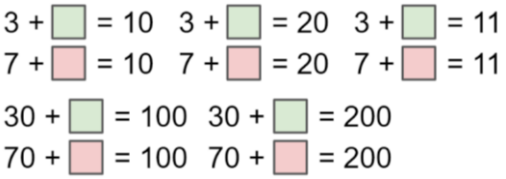
The answer is . . . , what is the question?



Children are able to challenge themselves to create complex calculations or more comfortable ones.
Add parameters e.g. Your questions must contain . . .

Focus this on an area of maths you have been teaching such as: number bonds, fractions, decimals, percentages, multiplication, division . . .

What do you notice about . . .



For example, when probed to say, 'If you know 3 + 7 = 10, what else do you know?' They should reply with answers, such as 13 + 7 = 20 or 4 + 7 = 11
I know that 3 + 7 = 10 and 4 is one more than 3. The answer must be 11.

Children make connections by using what they do know and applying it to a problem to find what they don't.

Types of questioning

Starter questions	***Questions to stimulate mathematical thinking***	***Assessment questions***	***Final discussion questions***
These take the form of open-ended questions which focus the children's thinking in a general direction and give them a starting point. **Examples:** How could you sort these.....? How many ways can you find to ..... ? What happens when we ..... ? What can be made from....? How many different ..... can be found?	These questions assist children to focus on particular strategies and help them to see patterns and relationships. The questions can serve as a prompt when children become 'stuck'. (Teachers are often tempted to turn these questions into instructions, which is far less likely to stimulate thinking and removes responsibility for the investigation from the child). **Examples:** What is the same? What is different? Can you group these ..... in some way? Can you see a pattern? How can this pattern help you find an answer? What do think comes next? Why? Is there a way to record what you've found that might help us see more patterns? What would happen if....?	Questions such as these ask children to explain what they are doing or how they arrived at a solution. They allow the teacher to see how the children are thinking, what they understand and what level they are operating at. Obviously they are best asked after the children have had time to make progress with the problem, to record some findings and perhaps achieve at least one solution. **Examples:** What have you discovered? How did you find that out? Why do you think that? What made you decide to do it that way? What else do you know now? How do you know that?	These questions draw together the efforts of the class and prompt sharing and comparison of strategies and solutions. This is a vital phase in the mathematical thinking processes. It provides further opportunity for reflection and realisation of mathematical ideas and relationships. It encourages children to evaluate their work. **Examples:** Who has the same answer/ pattern/ grouping as this? Who has a different solution? Are everybody's results the same? Why/why not? Have we found all the possibilities? How do we know? Have you thought of another way this could be done? Do you think we have found the best solution?