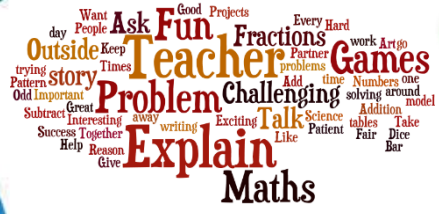


The Russell School

Maths Calculation Policy

The Russell School
Petersham

Updated: February 2016

About Our Calculation Policy

This documents is written for all adults working with our pupils; including teachers, teaching assistants, students, supply teachers and parents. It should be part of an induction package for all staff with inset as appropriate.

Our Calculation Policy has been devised to meet the requirements of the National Curriculum 2014, but most importantly the learning needs of our children at the Russell. The policy has been designed to give pupils a consistent and smooth progression of learning calculations across the school. Teachers should refer to this policy in all planning for calculations including cross curricular links.

The calculation policy is organised according to the requirements that need to be embedded in each year group of the primary curriculum as set out in the National Curriculum 2014; one set of mathematical concepts and big ideas for all. One of our fundamental mathematical Key principles; that this policy has been derived from, is the assumption that children use the language of maths correctly, so that children can develop mathematical concepts and also allows teachers to address misconceptions early and ensure that children have a firm understanding of key mathematical concepts before moving on.

It is vital that children are taught according to the 'stage' that they are working at, the transition between stages should not be hurried as not all children will be ready to move on to the next stage at the same time. Throughout this policy stages have been developed which introduces new concepts, outlines appropriate manipulatives and visual models, and what mathematical language is involved for a particular concept. Latter stages are for those children who are showing to have 'mastered' a concept, allowing them to apply their learning in a real life context further deepening their understanding. The new curriculum focuses on skills and mastery and is not about moving children on to the next method as soon as they can do the one before.

Written methods of calculations are based on mental strategies that have been taught using appropriate manipulatives and are only expected once a child has a clear understanding of the processes involved. This policy uses pictorial models that are consistent across year groups which means that skills can be taught, practised and reviewed constantly. These skills lead to more formal written methods of calculation.

Strategies for calculation need to be supported by familiar models and methods to reinforce understanding, such as the whole part model which children are exposed to throughout this policy. The written methods in this document are important but they by no means replace the superb mental methods we have developed. It is important for children to handle manipulatives to develop and reinforce understanding at all stages from Foundation to Year Six. A sound understanding of the number system and the value of a given number (place value) is essential for children to carry out calculations efficiently and accurately. Efficiency in calculation requires having a variety of mental strategies, which are carefully taught at a particular stage in a child's learning. Another key principle is the importance of 10, referred to as 'magic 10' (NCETM, 2015), which allows children to partition numbers to bridge 10, for example 9+6=9+1+5=15, which is helpful to make 10 as this makes this calculation easier.

Children need to be taught and encouraged to communicate their reasoning and thinking at all stages. Confidence in their ability in mathematics and calculations should be encouraged and supported with all children, fostering a 'can do' attitude. The long term aim is for our children to be able to select an efficient method of their own choice asking systematically:

Can I do this in my head?

Can I do this using drawings or jottings?

Do I need to use a pencil and paper procedure?

What resources could I use to help me?

A Malin

January 2016

Year Five

Children in Year Five continue to consolidate bonds of numbers up to 100 using the whole part model to derive their associated fact families, identify the place value in large whole numbers and read Roman numerals to 1000 (M) and recognise years written in Roman numerals. Pupils continue to use number in context, including measurement and extend and apply their understanding of the number system to the decimal numbers and fractions that they have met so far. Children solve problems involving addition, subtraction, multiplication and division and a combination of these, including understanding the meaning of the equals sign, including in missing number problems (for example, 13 + 24 = 12 + 25; 33 = 5 x). They are taught to recognise and use square numbers and cube numbers, and the notation for squared (^{2}) and cubed (^{3}) to solve problems involving multiplication and division including using their knowledge of factors and multiples.

By the end of Year Five, children should use and understand the terms: factor, multiple and prime, square and cube numbers.

Pupils interpret non-integer answers to division by expressing results in different ways according to the context, including with remainders, as fractions, as decimals or by rounding. Children should use multiplication and division as inverses to support the introduction of ratio in year 6, for example, by multiplying and dividing by powers of 10 in scale drawings or by multiplying and dividing by powers of a 1000 in converting between units such as kilometers and meters and begin to understand and apply the laws of distribution (E.g a(b + c) = ab + ac).

Key Vocabulary: place value, millions, hundreds of thousand, tens of thousand, thousands, hundreds, tens, ones, value, whole, parts, inverse, operation, addition, subtraction, multiplication, division, algebra, expression, equation, exchanging, regroup, tenths, hundredths, decimal point, rounding, prime number, factor, prime number, whole number, fraction, remainder, multiple, divisor, quotient, bar model, array, denominator, improper fractions, mixed number, percentages, inverse, fact family, square number, square roots, laws of distribution.

Key Instant Recall Facts

Autumn 1: I know decimal bonds to 1 and 10.

Autumn 2: I know the multiplication and division facts for all times tables up to 12 x 12.

Spring 1: I can recall metric conversions.

Spring 2: I can identify prime numbers up to 20.

Summer 1: I can recall square numbers up to 12^2 and their square roots.

Summer 2: I can find factor pairs of a number.

Number-Number and place value

Read, write, order and compare numbers to at least 1 000 000 and determine the value of each digit.
Interpret negative numbers in context, count forwards and backwards with positive and negative whole numbers, including through zero.
Round any number up to 1 000 000 to the nearest 10, 100, 1000, 10 000 and 100 000.
Count forwards or backwards in steps of powers of 10 for any given number up to 1 000 000.
Solve number problems and practical problems that involve all of the above.

How many **lots of 100** does the number 112 323 have?

Is the number 641 000 000 **smaller than** the number 34 500 000?

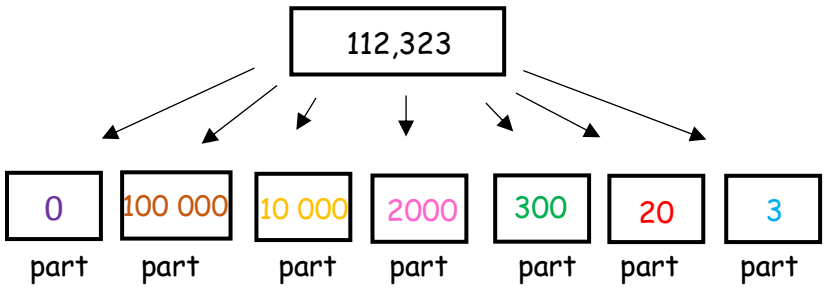
The temperature in England today is 2°C and the temperature in Greenland today is -6°C, what is the **difference** in temperature between these two countries?

Phase 1

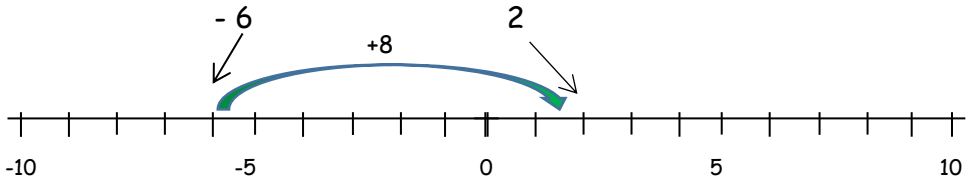
Millions place	Hundreds of Thousands place	Tens of Thousands place	Thousands place	Hundreds place	Tens place	Ones place
	100 000	10 000	1000 1000	100 100 100	10 10	1 1 1

Use a partitioning grid to develop mathematical understanding and language.

Record using whole part model alongside a bar model:



Phase 2



Use a number line to plot negative and positive numbers in a context (such as temperature) to develop mathematical understanding.

The difference between these two temperatures is 8°C.

Number- Addition and Subtraction

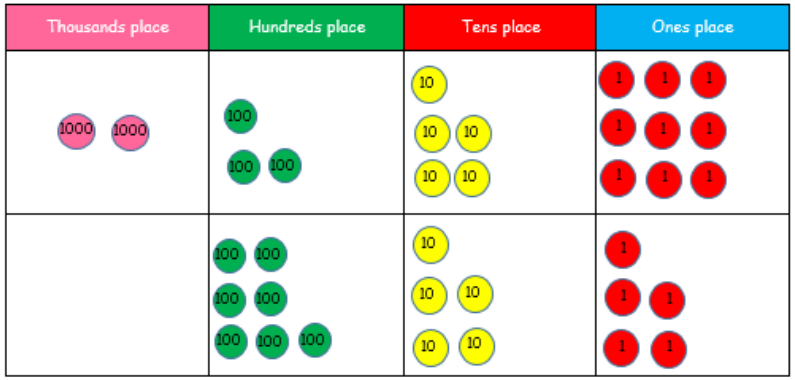
Add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction).
Add and subtract numbers mentally with increasingly large numbers.
Use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy.
Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why.

Addition (The process of finding the total of two or more sets)

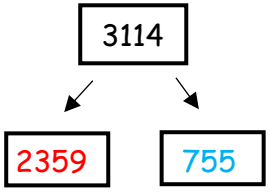
Phase 1- Adding whole numbers with more than four digits

David had 2359 toys and Adam had 755 toys. How many toys did they have **altogether**?

Stage 1



Use a place value grid alongside partitioning arrow cards to develop mathematical understanding and language.
Record using whole part model:



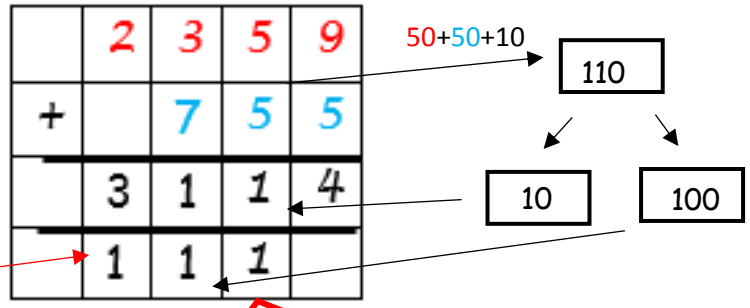
Note: Children should be taught to estimate equation first using rounding to nearest 10/100.

EG: 2359 + 755 -> **2400 +760= 3160**

Record using compact column addition, children to use whole part model when partitioning to continue to develop mathematical understanding of place value:

Note: Ensure children place numbers in a column fashion.

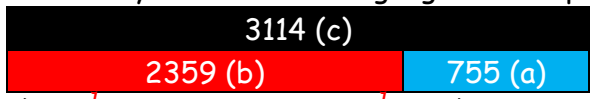
Note: Children to draw a line under final calculation and to carry under the line.



5 **lots of tens** add 5 **lots of tens** add 1 **lot of ten equals** 11 **lots of ten** (Record as 1 **lot of hundred** and 1 **lot of ten**)

Develop mathematical reasoning using bar model.

Record as a fact family while introducing algebraic expression.



$a + b = c$ $\quad b + a = c$

$755+2359=3114$ $\quad 2359+755=3114$

$c - a = b$ $\quad c - b = a$

$3114-755=2359$ $\quad 3114-2359=755$

Phase 2- Adding numbers up to three decimal places (including money, measures and decimals with different number of decimal)

David went to the shops and spent £19.01 on toys, £3.65 on food and 70p on a drink. How much did he spend **altogether**?

Stage 1

Note: Children need to understand when using a place value grid with fixed decimal point for money that the ones represents a single £1 coin.

Hundreds	Tens	Ones	Tenths	Hundredths
	1	9	0	1
		3	6	5
			7	0
	2	3	3	6
	1	1		

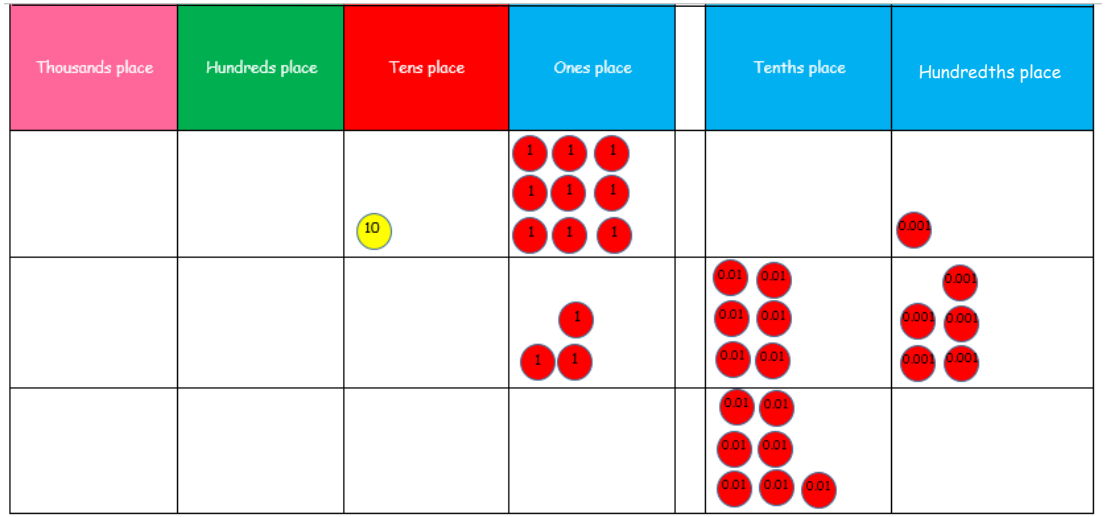
Note: Children should be taught to estimate equation first using rounding to nearest 1/10/100.

EG: 19.01 + 3.65 +0.70 -> **19 +4 +1= 24**

Record using compact column addition and continue to develop mathematical understanding of place value:

	1	9	.	0	1
		3	.	6	5
+		0	.	7	0
	2	3	.	3	6
	1	1			

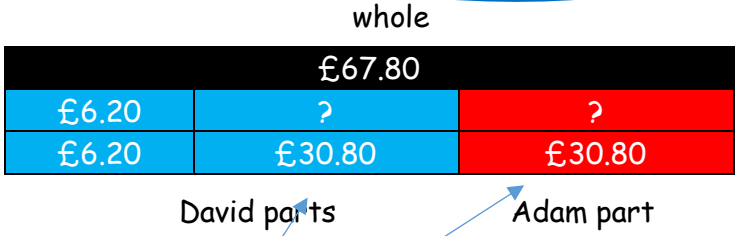
Note: Empty decimal places should be recorded with zero to recognise it as a place holder.



Use a place value grid alongside a decimal grid with **fixed decimal points** to develop mathematical understanding and language.

Develop mathematical reasoning using bar model.

David and Adam have £67.80 between them. If David has £6.20 more than Adam, how much does Adam have?



$67.80 - 6.20 = 61.60$

$61.60 \div 2 = 30.80$ (So Adam has £30.80)

Subtraction- Calculating the difference (The process of taking away and counting how many are left)

Phase 1- Subtracting whole numbers with more than four digits **with exchanging**

David had 2754 cards and sold 1562. How many did he have **left**?

Note: Partitioned column subtraction method should be used alongside a place value grid to support children with **exchanging**.

Children should be secure at partitioning a given number into thousands, hundreds, tens and ones.

Stage 1

2	7	5	4	-	1	5	6	2	=	1	1	9	2	
							600				1			
		2	0	0	0	and	~~7~~	~~0~~	~~0~~	and	5	0	and	4
	-	1	0	0	0	and	5	0	0	and	6	0	and	2
		1	0	0	0	+	1	0	0	+	9	0	+	2

Note: When **exchanging children** should record new value above the line.

Use base 10 alongside a place value grid to develop understanding of mathematical process of **exchanging**.

Record using partitioned column subtraction method.

Stage 2

		6	1	
	2	X	5	4
-	1	5	6	2
	1,	1	9	2

15 **lots of ten** minus 6 **lots of ten** equals 9 **lots of ten**.

Note: Only introduce compact column method when:

Children are **very secure** and confident with using expanded column method for addition.

Note: Children should be taught to estimate equation first using rounding to nearest 10/100.

EG: 2754 - 1562 -> **2750 - 1560 = 1190**

Using compact column addition method to record.

Phase 2- Subtracting numbers up to three decimal places **with exchanging** (including money, measures and decimals with different number of decimal)

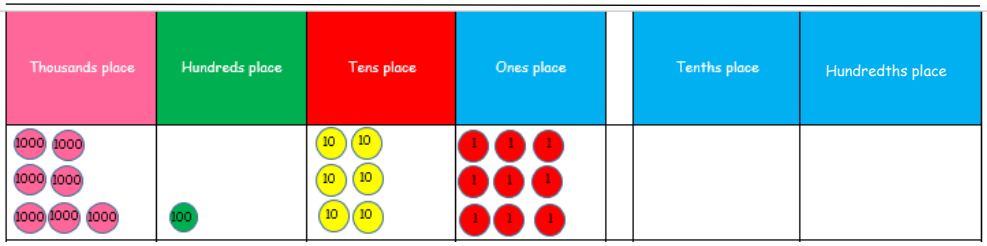
David had £7169 and spent £372.50, how much did he have **left**?

Note: Children should be taught to estimate equation first using rounding to nearest 1/10/100.

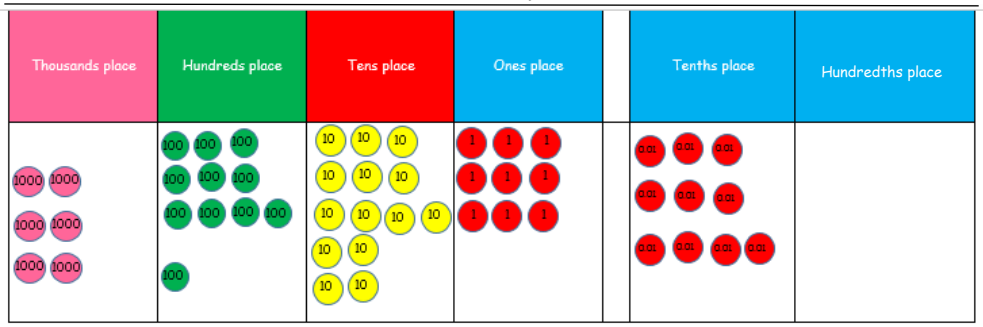
EG: 7169 - 372.50 -> **7170 - 370 = 6800**

Stage 1

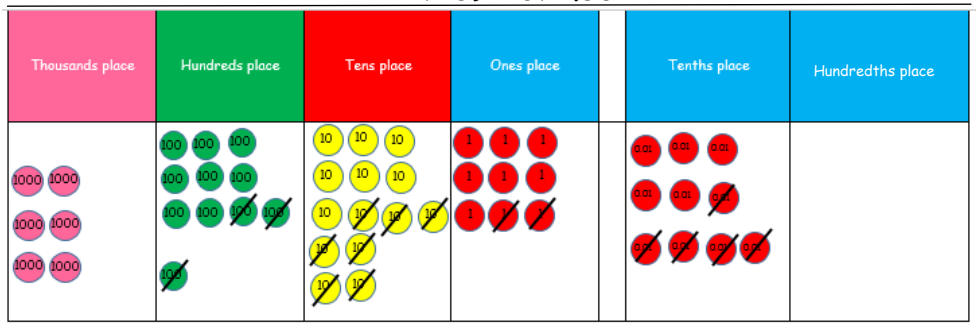
7169



7169



7169 - 372.50



Use a place value grid to develop mathematical understanding and language.

Record using compact column addition and continue to develop mathematical understanding of place value:

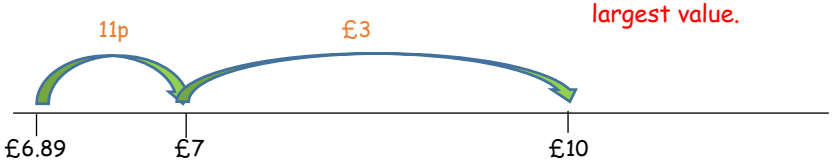
	6	10	1	8		1
	~~7~~	~~1~~	6	~~9~~	.	0
-		3	7	2	.	5
	6	7	9	6	.	5

Note: Empty decimal places should be filled with zero to recognise it as a place holder.

Develop mathematical subtraction using a blank number line.

David spent £6.89 in a shop and paid using a £10 note. How much change did he get?

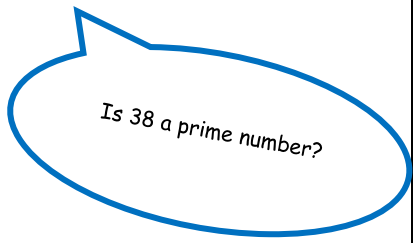
Note: Children to find the difference by counting on from the smallest value to the largest value.



David got £3.11 change.

Number- Multiplication and division

Identify multiples and factors, including finding all factor pairs of a number, and common factors of two numbers.
Know and use the vocabulary of prime numbers, prime factors and composite (non-prime) numbers.
Establish whether a number up to 100 is prime and recall prime numbers up to 19.



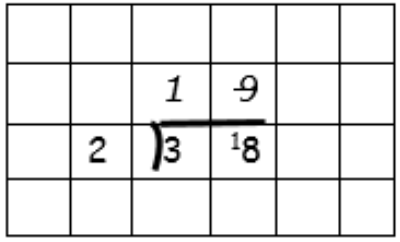
Prime number facts:

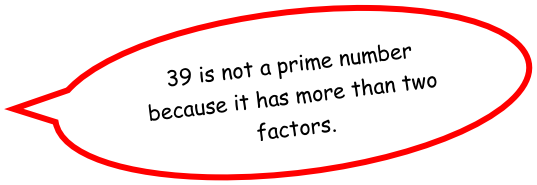
- A prime number has just 2 factors, itself and the number 1
- The only even prime number is 2. All other even numbers can be divided by 2
- If the sum of a number's digits is a multiple of 3, that number can be divided by 3
- No prime number greater than 5 ends in a 5. Any number greater than 5 that ends in a 5 can be divided by 5
- Zero and 1 are not considered prime numbers
- Except for 0 and 1, a number is either a prime number or a composite number. A composite number is defined as any number, greater than 1, that is not prime

Prime numbers up to 19		
2	3	5
7	11	13
17	19	

Note: To prove whether a number is a prime number, first try dividing it by 2, and see if you get a whole number. If you do, it can't be a prime number.

Children to investigate prime numbers and record using short division:





If you don't get a whole number, next try dividing it by the prime numbers: 3, 5, 7, 11 (9 is divisible by 3) and so on, always dividing by a prime number.

A factor of a given number is every number that divides exactly into that number.

Example: Write down all factors of 15.

15 = 3 x 5, so the numbers 3 and 5 are factors of 15.

Also 15= 15 x 1, so 15 and 1 are also factors of 15.

The factors of 15 are 1,3,5,15

Note: Number 1 and the number itself are always factors of any number.

Multiply numbers up to 4 digits by a one or two-digit number using a formal written method, including long multiplication for two-digit numbers.
Multiply and divide numbers mentally drawing upon known facts.
Divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context.
Solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates.

David found 5 boxes with 135 toys in each box, how many toys were there altogether?

Multiplication

Phase 1- Multiply up to a four digit number by a one digit number

Stage 1

135 x 5 = 675

x	5
100	500
30	150
5	25
	675

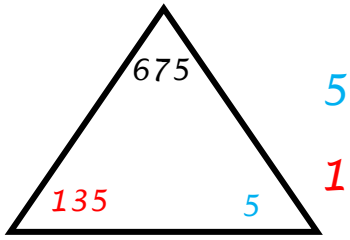
Note: Children to check their answer using an estimation equation rounding to the nearest hundred and ten that they can mentally multiply using know multiplication facts.

135 x 5= (approximately) 140 x 5=700

Note: Once calculated children can use expanded column addition to find the total.

Use grid method to develop mathematical understanding.

Record using a trio to develop mathematical reasoning:



5 x 135 = 675

135 x 5 = 675

I have noticed that you can multiply 135 x 5 or 5 x 135 and it still totals 675.

Stage 2

Use expanded multiplication method alongside place value counters to develop mathematical understanding.

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

Stage 3

Record short multiplication method alongside grid method to develop mathematical understanding.

		1	3	5	
	x			5	
		6	7	5	
		1	2		

Note: Ensure children carry under the line.

Phase 2- Multiply up to a four digit number by a two digit number

A shop ordered 18 boxes of toys, each box had 13 toys inside. How many toys were there **altogether?**

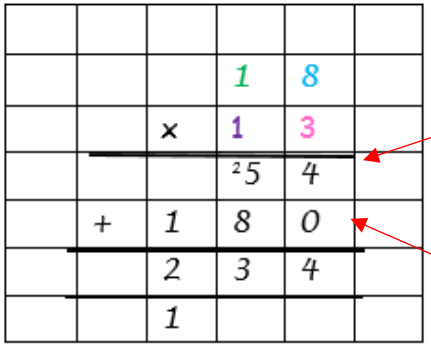
Stage 1- Introducing long multiplication

18 x 13 = 234

x	10	3
10	100	30
8	80	24
	180 +	54

Use grid method alongside place value counters to develop mathematical understanding.

Record using long multiplication method:



Note: Children to compare grid method to long multiplication method to develop understanding.

18 x 3 on the first row.

(8x3=24, carrying the 2 for twenty, then 1x3).

18 x10 on the second row. Put a zero in the ones column to acknowledge the 0 as a place holder. Then say 8 x 10 and 10 x 10.

A shop ordered 25 boxes of toys, each box had 135 toys inside. How many toys were there **altogether?**

Stage 2- Moving onto more complex numbers.

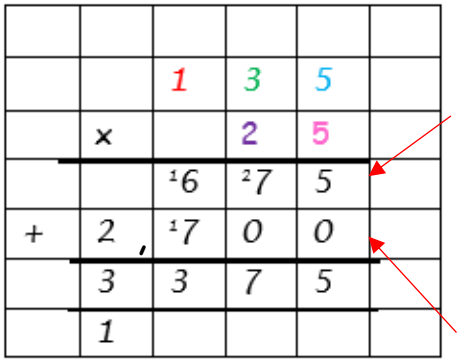
135 x 25 = 3375

x	20	5
100	2000	500
30	600	150
5	100	25
	2700 +	675

Note: Once calculated children can use expanded column addition to find the total.

Use grid method alongside place value counters to develop mathematical understanding.

Record using long multiplication method:



Note: Children to compare grid method to long multiplication method to develop understanding.

135 x 5 on the first row.

(5x5=25, carrying the 2 for twenty, then 5x30=150 +20 =170. Carrying the 1 for one hundred, then, 5x100=500+100=600

135 x20 on the second row. Put a zero in the ones column to acknowledge the 0 as a place holder, then say 5x20, 30x20 and 100x20

Division

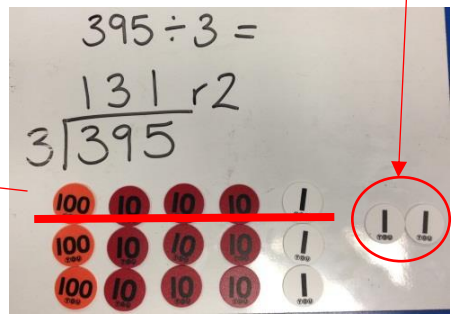
Divide up to a 4 digit number by a single digit number **with and without remainders in the final answer.**

A 395 cm piece of ribbon is cut into 3cm equal pieces. How many pieces can be cut from the ribbon?

Stage 1

Any counters that cannot be grouped are the remainder. Write this at the end as r2.

What is 2678 ÷ 15?



As you look across each group, the quotient can be seen.

Divisor

A number by which another number is to be divided by.

Multiple or Dividend

A number that may be divided by another a certain number of times.

$18 \div 3 = 6$

Quotient

A number that is the result obtained by dividing one quantity by another.

Record using short division method using place value counters for support.

Use a bar model alongside short division method to develop mathematical reasoning:

A one metre piece of ribbon is cut into equal pieces and a piece of 4cm is left over. How many pieces can be cut from the ribbon?

9	6	÷	4	=	2	4	
		2	4				
	4	9	ⁱ6				

100 cm	
4 cm	100cm - 4cm = 96cm

You can cut 24 equal pieces of ribbon.

Stage 2- Introducing Long division (Dividing by a 2 digit number)

Before introducing long division method children should be confident and accurate applying the short division method and have problem solved in different contexts including money and measure.

Note: 15 ÷ 2 =0 (Record 0)

26÷15 =1 + remainder (Record 1)

To find remainder 26-15 (1 lot of 15)=11

Now, bring down 7.

117÷15= 7 + remainder (Record 7)

To find remainder 117-105 (7 lots of 15)=12

Now, bring down 8.

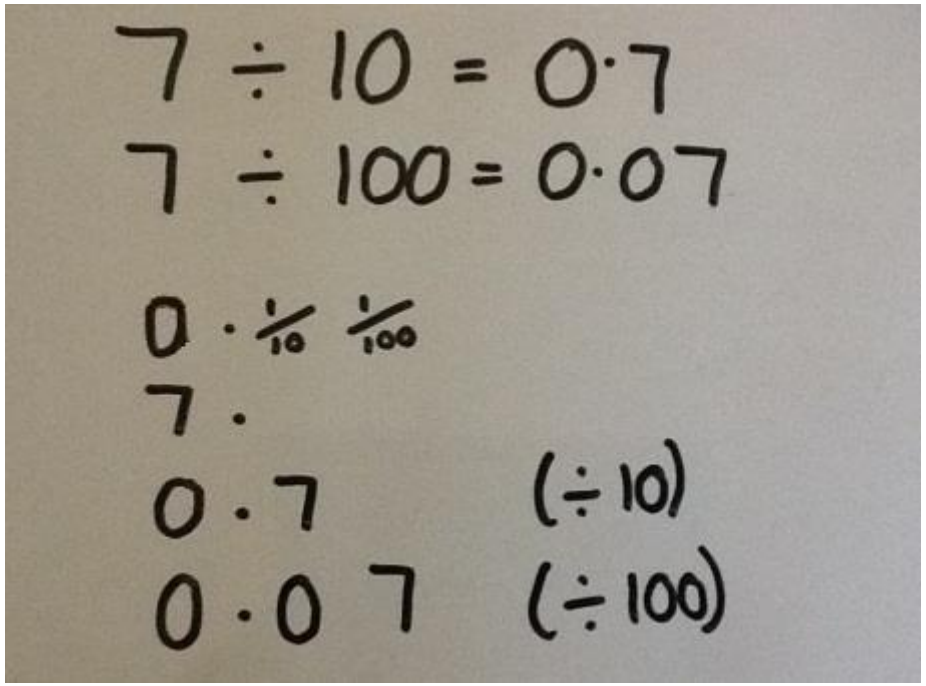
128÷15 = 8 + remainder (Record 8)

To find remainder 128-120 (8 lots of 15)=8

2	6	7	8	÷	1	5	=	1	7	8	r8	
		0	1	7	8	r8						15
1	5	2	6	7	8							30
	-	1	5									45
		1	1	7								60
	-	1	0	5								75
		0	1	2	8							90
	-		1	2	0							105
			0	0	8							120

Note: Children should make a list of multiples for the divisor (x15 table) to ease calculation.

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

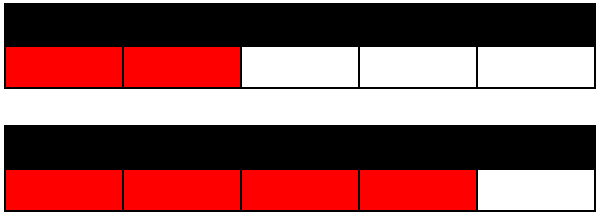


Number- Fractions (including decimals and percentages)

Compare and order fractions whose denominators are all multiples of the same number.
Add and subtract fractions with the same denominator and denominators that are multiples of the same number.
Recognise mixed numbers and improper fractions and convert from one form to the other and write mathematical statements > 1 as a mixed number [for example, 2/5 +4/5= 6/5 =1 1/5].

David ate 2/5 of his pizza and Adam ate 4/5 of his pizza, how much pizza did they eat?

Stage 1- Comparing, adding and subtracting fractions that have the same denominator

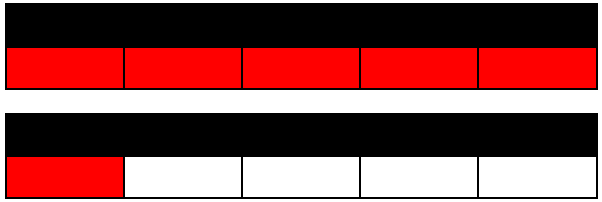


2/5 means that I need to have 5 equal parts and 2 parts are shaded.

Use a bar model alongside an array to support mathematical understanding.
Record as fraction equation.

$$\frac{2}{5} + \frac{4}{5} = \frac{6}{5}$$

Stage 2- Converting improper fractions to mixed numbers

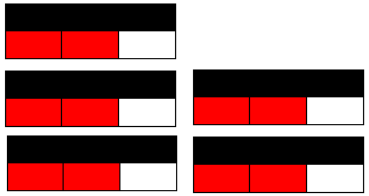


Use a bar model alongside an array to support mathematical understanding.
Record as fraction equation.

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

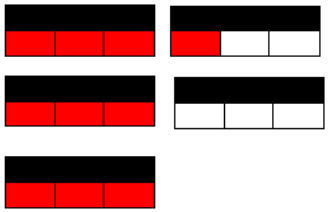
Multiply proper fractions and mixed numbers by whole numbers, supported by materials and diagrams.

5 friends each ordered a pizza and they each ate $\frac{2}{3}$ of their pizza. How much did they eat in total?



Note: Each bar model represent a pizza, we know that each person ate $\frac{2}{3}$ of their pizza. So we shade in 2 parts representing the eaten pizza, and leave one part representing the uneaten pizza.

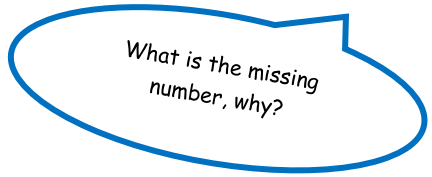
We can see that there are 10 parts in total that has been shaded.



Use a bar model and Unifix cubes alongside an array to support mathematical understanding.
Record as fraction equation.

5 **lots of** $\frac{2}{3} = \frac{10}{3}$ or $3\frac{1}{3}$ pizzas

Recognise and use thousandths and relate them to tenths, hundredths and decimal equivalents.
Round decimals with two decimal places to the nearest whole number and to one decimal place.
Read, write, order and compare numbers with up to three decimal places.
Solve problems involving number up to three decimal places.

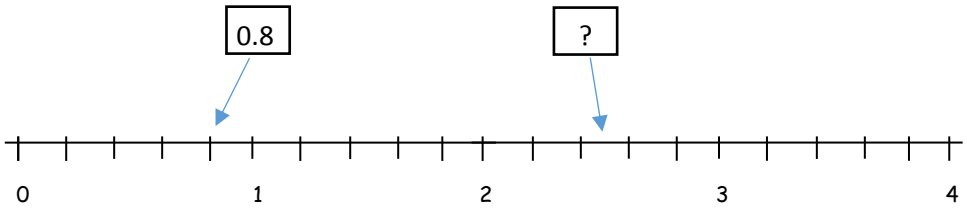


Stage 1

Hundreds	Tens	Ones	Tenths	Hundredths	Thousandths
		3	0	4	
0	2	7	5		
	4	3	1	1	
5	6	0	3		

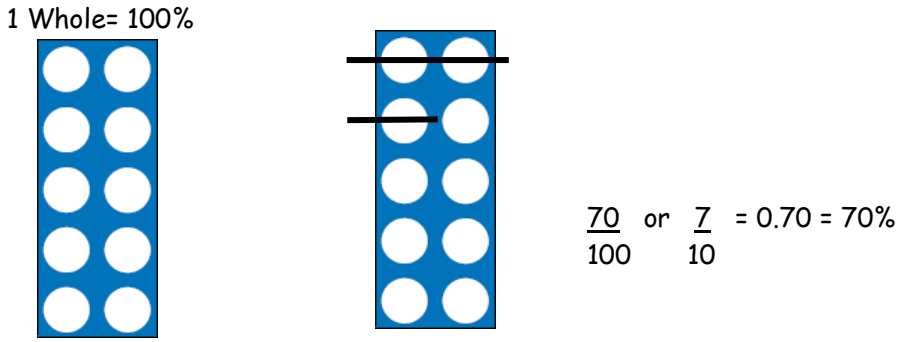
Use a decimal grid with a **fixed decimal point** alongside a fraction wheel to support mathematical process and continue to develop mathematical understanding of place value.

Stage 2



Use a number line to develop mathematical understanding of place value in a **context**, such as temperature.

Recognise the per cent symbol (%) and understand that percent relates to 'number of parts per hundred', and write percentages as a fraction with denominator 100, and as a decimal.
Read and write decimal numbers as fractions [for example, 0.71 = 71/100].



$\frac{70}{100}$ or $\frac{7}{10}$ = 0.70 = 70%

Use Numicon alongside an array to support mathematical process and understanding of relationship between fractions, decimals and percentages.