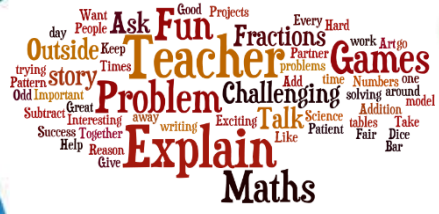


The Russell School

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 Four

Children in Year Four begin to extend their knowledge of the number system to include the decimal numbers and fractions that they have met so far. They connect estimation and rounding numbers to the use of measuring instruments.
Children are taught to recognise and write Roman numerals to 100 (I and C) and begin to understand that there have been different ways to write whole numbers and that the important concepts of zero and place value were introduced over a period of time.
By the end of Year Four, children should be fluent in recalling and using all multiplication tables and related division facts and be able to use mental methods to solve a given problem. Pupils should also apply their mathematical knowledge of fact families to three-digit numbers to derive facts, (for example 600 ÷ 3 = 200 can be derived from 2 x 3 = 6).

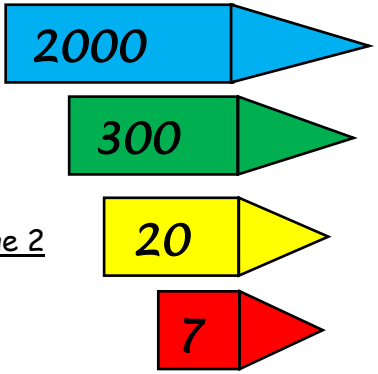
Key Vocabulary: place value, thousands, hundreds, tens, ones, digit, operation, addition, subtraction, multiplication, division, expanded method, compact method, exchanging, inverse operation, fact family, part, whole, part, array, partition, remainder, multiple, divisor, whole number, fraction, denominator, tenths, hundredths, decimal.

Key Instant Recall Facts

Autumn 1: I know number bonds to 100.
Autumn 2: I know the multiplication and division facts for the 6 times table.
Spring 1: I know the multiplication and division facts for the 9 and 11 times table.
Spring 2: I can recognise decimal equivalents of fractions.
Summer 1: I know the multiplication and division facts for the 7 times table.
Summer 2: I can multiply and divide single-digit numbers by 10 and 100.

Number- Number and place value

Recognise the place value of each digit in a four-digit number (thousands, hundreds, tens, and ones).
Identify, represent and estimate numbers using different representations.
Find 1000 more or less than a given number.
Order and compare numbers beyond 1000 and round any number to the nearest 10, 100 or 1000.
Solve number and practical problems that involve all of the above and with increasingly large positive numbers.



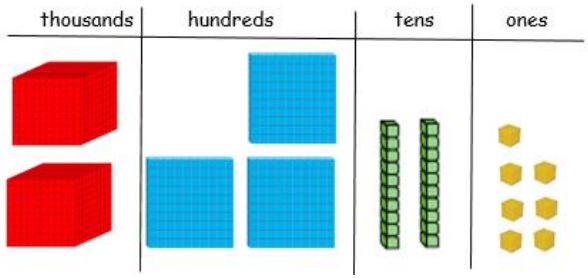
Stage 1

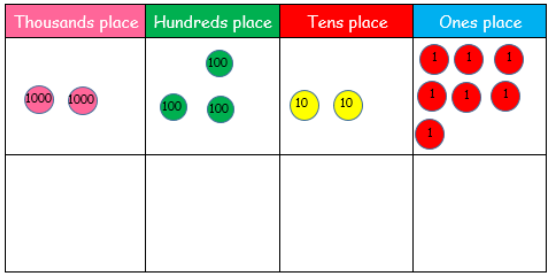
What is the **value** of each **digit** in the number 2327?

The 3 has a **value** of 300 because there are 3 **lots of a hundred** in the **hundreds column**.

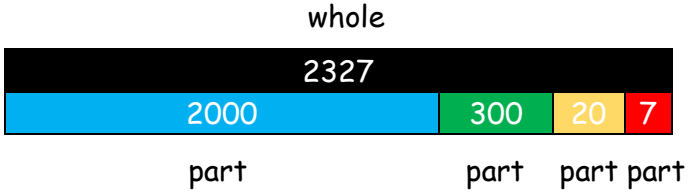
There are 2 **lots of** thousands, 3 **lots of hundred**, 2 lots **of ten** and 7 **lots of one**. Altogether there are 2327.

Stage 2



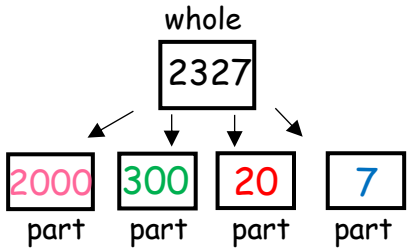


Use base 10 alongside a place value grid to develop mathematical understanding and language.



Use place value arrow cards alongside a bar model to develop mathematical understanding and reasoning.

Record using whole part model:

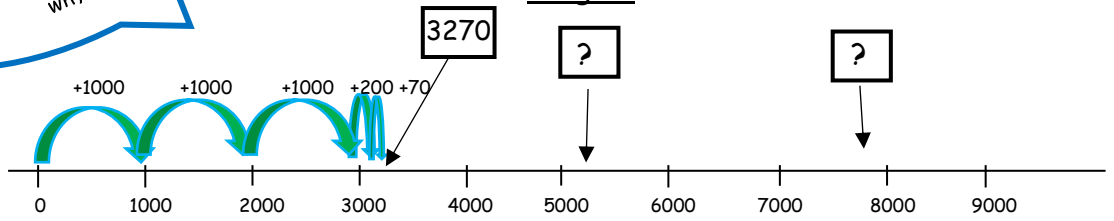


What could the missing numbers be, why?

Record using an equation:

2	3	2	7	=	2	0	0	0	+	3	0	0	+	2	0	+	7

Stage 3



Use a blank number line to develop mathematical understanding and language.

Count in multiples of 6, 7, 9, 25 and 1000.

Use a hundred square to investigate place value and number patterns developing children's mathematical reasoning.

Counting on in 6s

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Counting on in 7s

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

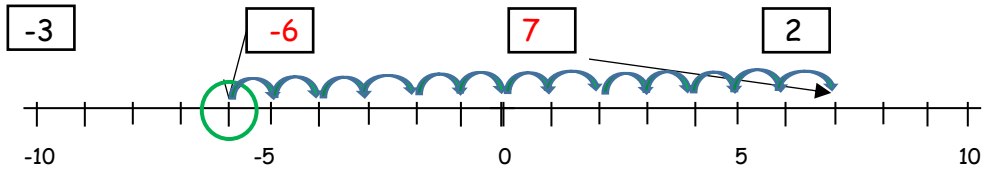
Counting on in 9s

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

I have noticed when finding **multiples** of 6 the **ones digit** is always an even number (2,4,6,8 or 0).

Count backwards through zero to include negative numbers.

Use a number line to count on and backwards when calculating positive and negative numbers to develop mathematical process (in the context of temperature)



Note: Children to be taught to find the **difference** between positive and negative numbers as a strategy.

Can you mark the temperatures -6°C and 7°C on the number line?

What is the difference between the warmest and the coolest temperature?

The **difference** is 13°C.

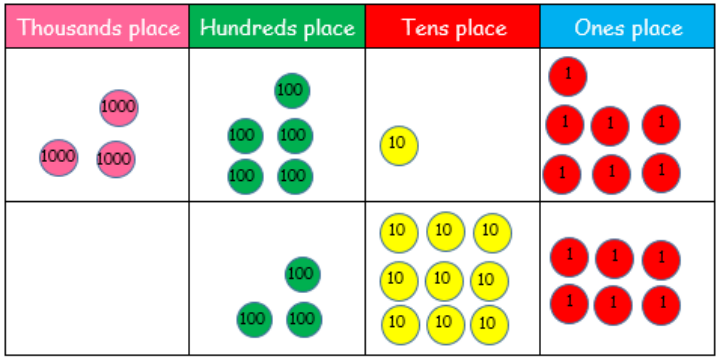
Number- Addition and Subtraction

Add and subtract numbers with up to 4 digits using the formal written methods of columnar addition and subtraction where appropriate.
Solve addition and subtraction two-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)

What is £396 **more than** £3517?

Stage 1



Use place value grid to develop understanding of mathematical process and language.

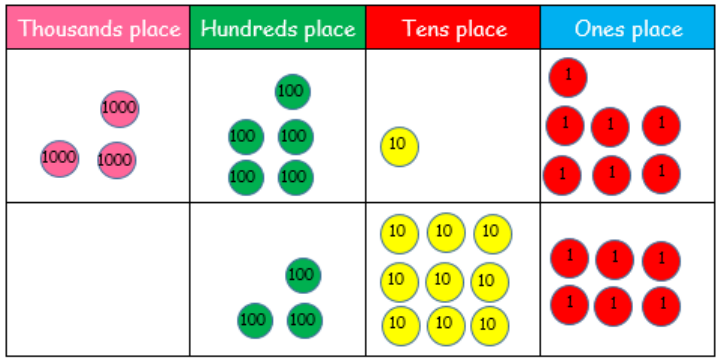
Record using **expanded** column addition method:

	3	5	1	7
+		3	9	6
			1	3
		1	0	0
		8	0	0
	3	0	0	0
	3,	9	1	3

Note: Children should be secure in partitioning a given number into thousands, hundreds, tens and ones without recording using partitioning.

What is £3517 **plus** £396?

Stage 2



Use place value grid to develop understanding of mathematical process of **carrying**.

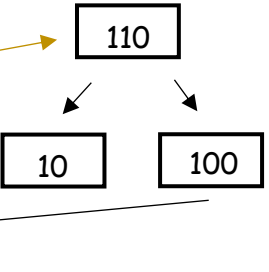
Record using **compact** column addition method, children to use whole part model when partitioning to continue to develop mathematical understanding of place value:

Note: Children should begin by adding the ones first and to carry any numbers underneath the bottom line.

Don't forget to remind children of the correct **place value**.

The actual value is **5 lots of hundred** add **3 lots of hundred**, not 5 add 3.

	3	5	1	7
+		3	9	6
	3	9	1	3
			1	1

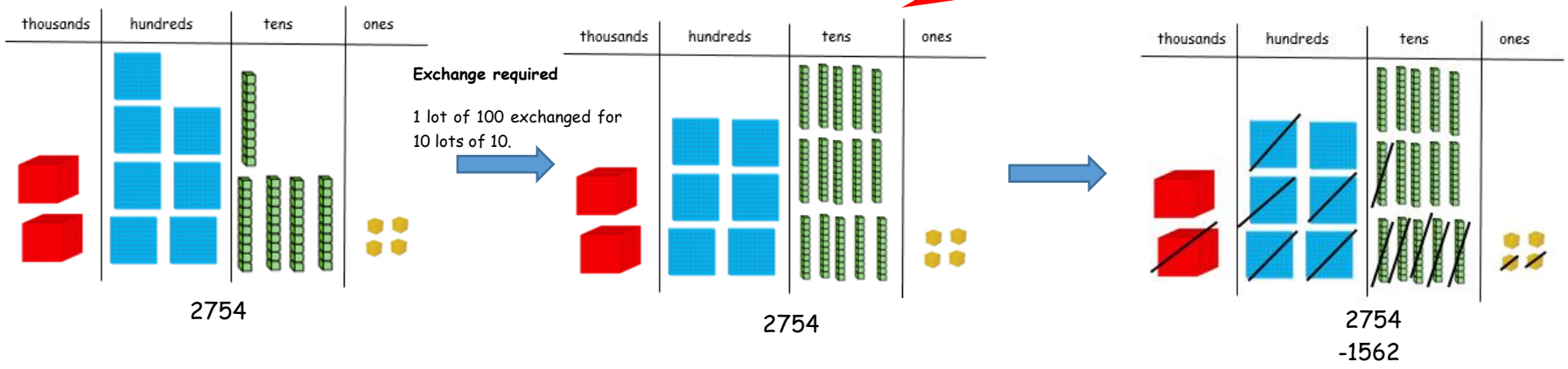


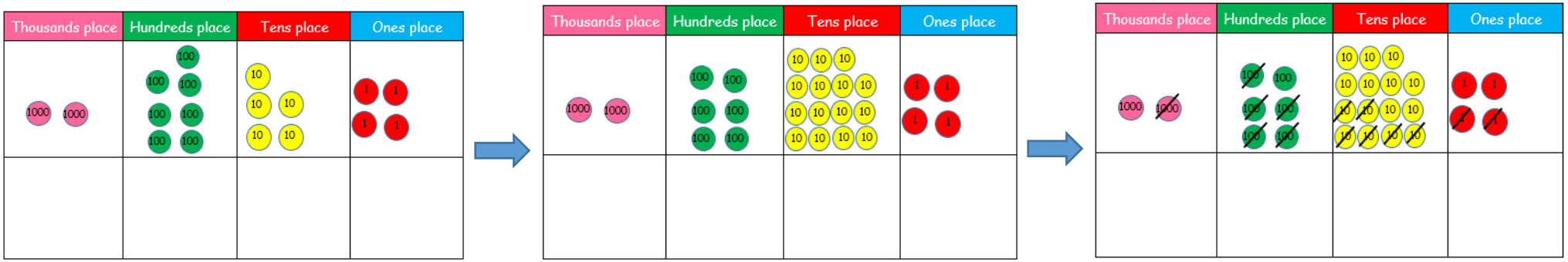
Subtraction- Calculating the difference (The process of taking away and counting how many are left)

David had £2754, he spent £1562. How much did he have **left**?

Stage 1

There were only 5 tens in the tens **column** and I needed to **take** away 6 **lots of ten**, so I had to **exchange** 1 **lot of hundred**.





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

Record using partitioned column subtraction method:

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

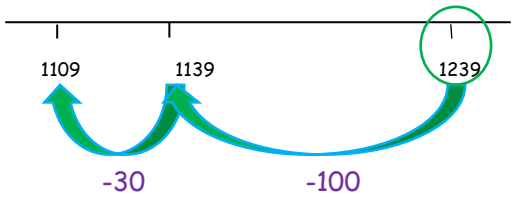
Children should be secure at partitioning a given number into thousands, hundreds, tens and ones.

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.

Stage 3

What is 1239 **minus** 130?



Note: To support mental calculations subtract to the nearest thousand, hundred or ten and then subtract the remainder.

Use a blank number line to model finding the difference and support mental maths process.

Record as an equation:

1	2	3	9	-	1	3	0	=	1	1	0	9		

Stage 2

Note: Only introduce compact column method when:

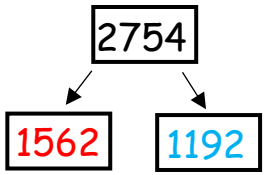
Children are **very secure** and confident with using expanded column method for addition.

		6	1	
	2	~~7~~	5	4
-	1	5	6	2
	1,	1	9	2

Using compact column addition method to record.

Investigate using whole part model to develop mathematical r and understanding of inverse.

Record as a fact family:



1	1	9	2	+	1	5	6	2	=	2	7	5	4			2	7	5	4	-	1	5	6	2	=	1	1	9	2
1	5	6	2	+	1	1	9	2	=	2	7	5	4			2	7	5	4	-	1	1	9	2	=	1	5	6	2

Estimate and use inverse operations to check answers to a calculation.

What is the **difference** between £396 and £3517?

Use bar model for addition and subtraction problems

whole

part part

Use a bar model to develop mathematical reasoning.

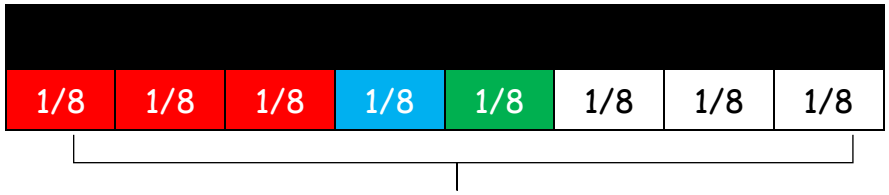
Record as a fact family:

3	5	1	7	+	3	9	6	=	3	9	1	3			3	9	6	+	3	5	1	7	=	3	9	1	3
3	9	1	3	-	3	9	6	=	3	5	1	7			3	9	1	3	-	3	5	1	7	=	3	9	6

What is the total of 3/8 +1/8 +1/8?

Use bar model for addition and subtraction of like fractions

whole



Each part represents 1/8 of the whole.

Use a bar model to develop mathematical reasoning.

Record as a fraction equation:

3	+	1	+	1	=	5
8		8		8		8

Number- Multiplication and Division

Use place value, known and derived facts to multiply and divide mentally, including: multiplying by 0 and 1; dividing by 1; multiplying together three numbers.

Recognise and use factor pairs and commutativity in mental calculations.

Multiply two-digit and three-digit numbers by a one-digit number using formal written layout.

Solve problems involving multiplying and adding, including using the distributive law to multiply two digit numbers by one digit, integer scaling problems and harder correspondence problems such as n objects are connected to m objects.

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

Multiplication

Multiply a two or three digit number by a single one digit number

Stage 1

135 x 5 = 675

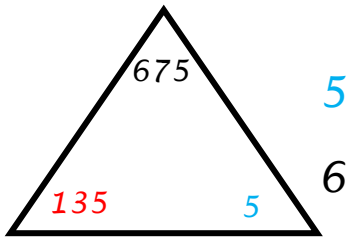
x	5
100	500
30	150
5	25
	675

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

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 a trio to develop mathematical reasoning:



5 x 135 = 675 135 x 5 = 675

675 ÷ 135 = 5 675 ÷ 5 = 135

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

Stage 2

Encourage children to check their answer using an estimation equation rounding to the nearest hundred and ten so that they can mentally multiply using know multiplication facts.

(E.g. 135 x 5 is approximately 140 x 5, encourage children to record their estimation to compare final calculation)

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

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

Division

What is 13÷4=?

A two or three-digit number by a single digit number **with no remainder in the final answer.**

Divisor

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

Multiple

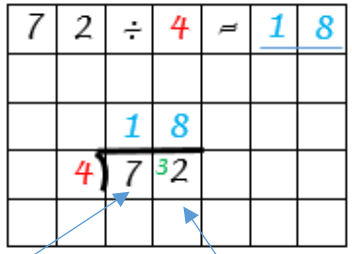
A number that may be divided by another a certain number of times.

$18 \div 3 = 6$

Stage 1- Dividing 2 digit numbers by a single digit.

When setting practice equations, ensure that no remainders in the final answer, but with remainders occurring within the calculation

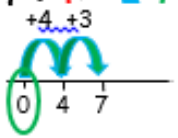
Note: Children must demonstrate a full understanding of remainders and also short division method of calculation.



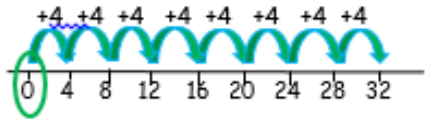
How many 4s in 7? =1 remainder 3, record the 1 above the 7 tens and the remainder (3 tens) next to the 2 ones.

How many 3s in 32? =8, record it above the 32 ones.

$7 \div 4 = 1 \text{ r } 3$



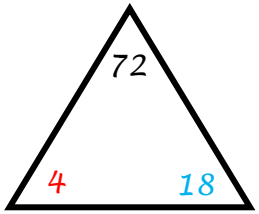
$32 \div 4 = 8$



Use a number line to support mathematical process calculating division facts.

Record using short division method alongside a trio with fact family to develop mathematical reasoning:

I have noticed that when you **divide** you start with the **whole**.



$72 \div 4 = 18$ $72 \div 18 = 4$

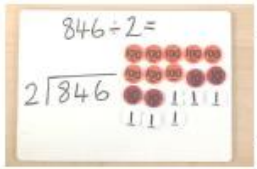
$18 \times 4 = 72$ $4 \times 18 = 72$

Stage 2- Dividing numbers up to 3 digits by a single digit.

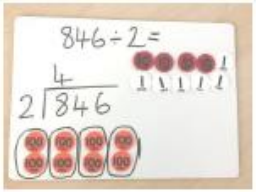
Ensure that no remainders in the final answer, but with remainders occurring within the calculation

Use Place Value counters to support mathematical process calculating division facts.

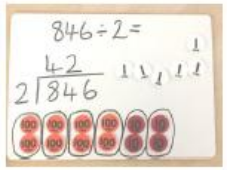
Record using short division method alongside a trio with fact family to develop mathematical reasoning.



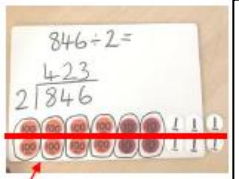
1. Create the dividend using Place Value counters.



2. Group the 100s counters according to the divisor. Write the number of groups above the line in the hundreds column.



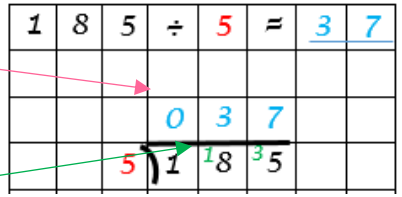
3. Next, group the 10s counters according to the divisor. Write the number of groups above the line in the tens column.



4. Now, group the 1s counters according to the divisor. Write the number of groups above the line in the ones column.

The quotient can be seen across the groups.

Note: When the first column is zero, children to write a 0 above the line to acknowledge the place holder and to carry over to the next digit as a **remainder**.



Recall multiplication and division facts for multiplication tables up to 12 × 12.

Use a hundred square to investigate place value and number patterns developing children's mathematical reasoning.

Counting on in 11s

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Counting on in 12s

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

I have noticed when finding **multiples** of 11 the **tens digit** and the **ones digit** is the same.

Use a bar model to develop mathematical reasoning when children are secure with the principle of multiplication and division.

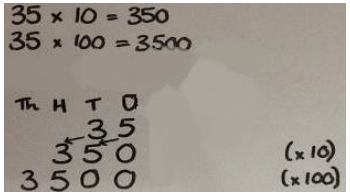
In a box there are 56 toys, David bought 7/8 of them. How many did he buy?

The **whole** is 56 and the **parts** are 8 because 56÷8=7.

David bought 49 toys altogether because 7x7=49.

Use place value to multiply and divide whole numbers by 10 or 100 and understand the effect.

Note: Children must be confident to partition a two-digit number to allow for mental multiplication when multiplying by 10 or 100. **Not just adding a zero!**



(Think: How many groups of 100?)

23 x 100 = 2300

20 x 100 = 2000

3 x 100 = 300

2000 + 300 = 2300

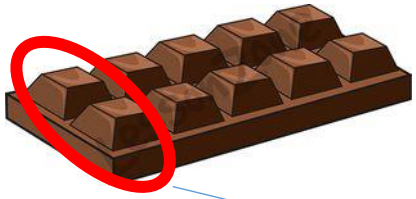
23x 100=2300 because I have multiplied 23 by one **lot of 100**.

Number- Fractions (including decimals)

Recognise and show, using diagrams, families of common equivalent fractions.
Count up and down in hundredths; recognise that hundredths arise when dividing an object by one hundred and dividing tenths by ten.
Solve problems involving increasingly harder fractions to calculate quantities, and fractions to divide quantities, including non-unit fractions where the answer is a whole number.
Add and subtract fractions with the same denominator.

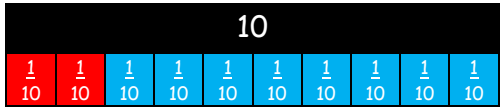
David had a chocolate bar that had 10 squares. He ate 2/10. How much of the bar did he eat?

Stage 1



Showing 2/10 of the chocolate bar.

Note: The denominator (whole) is 10 which represents the whole of the chocolate bar.



Note: The parts have been divided into 10 equal parts as the denominator is 10, each part represents 1 square of chocolate.

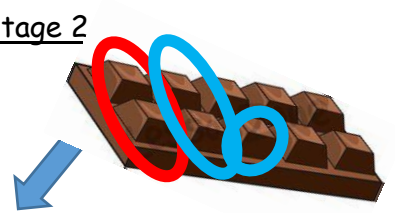
Use pictures alongside a bar model to support mathematical process and develop mathematical language.

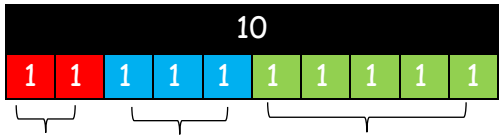
Record using a statement:

$\frac{2}{10}$ *of the chocolate bar is 2 squares.*

A chocolate bar had 10 squares. David ate 2/10 and Adam ate 3/10, how much of the bar was left?

Stage 2



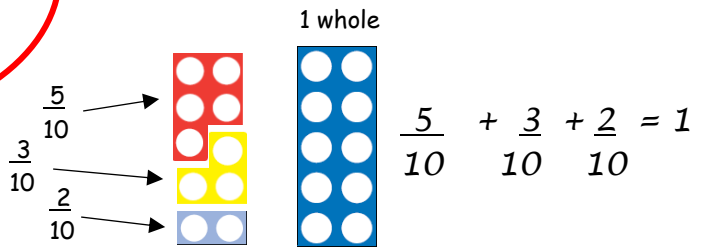


Use pictures and Numicon alongside a bar model to support mathematical process.

Record using a fraction equation:

$\frac{2}{10} + \frac{3}{10} = \frac{5}{10}$ *or* $1 - \frac{5}{10} = \frac{5}{10}$

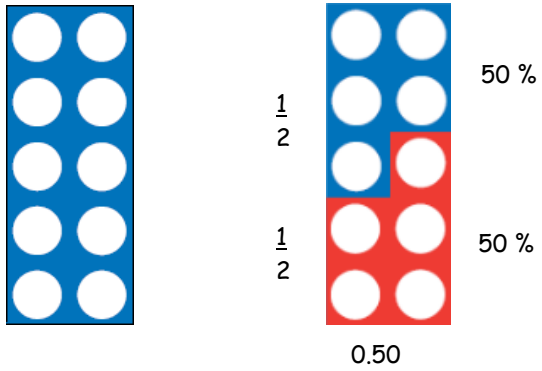
We are adding tenths… 2 tenths plus 3 tenths equals 5 tenths. The denominator stays the same – tenths, because that is the total number of parts.



$\frac{5}{10} + \frac{3}{10} + \frac{2}{10} = 1$

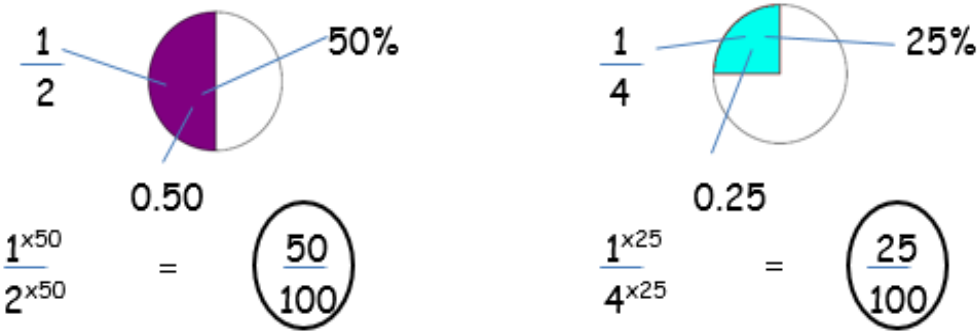
Recognise and show, using diagrams, families of common equivalent fractions.
Recognise and write decimal equivalents to $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$.

Stage 1



Stage 2

Children need to have an understanding that the whole is 100% or 1.0



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

Use pictures alongside a fraction wheel to support mathematical process and understanding of relationship between fractions, percentages and decimals.

Can you prove that 50% = 0.50

Record as an equation fact family:

$$\frac{5}{10} = \frac{50}{100} = 50\% = 0.50$$

Recognise and write decimal equivalents of any number of tenths or hundredths.

Hundreds	Tens	Ones	Tenths	Hundredths
		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 place value grid or fraction wheel to support mathematical process.