

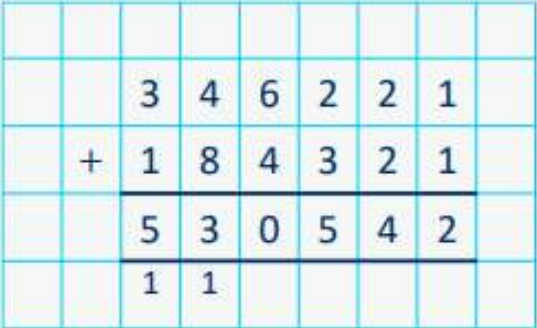
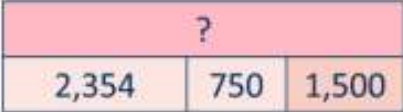
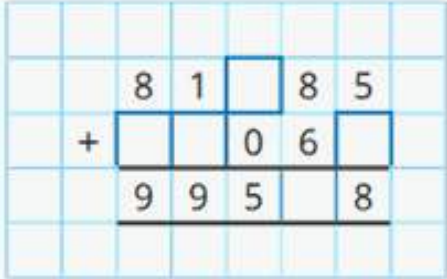
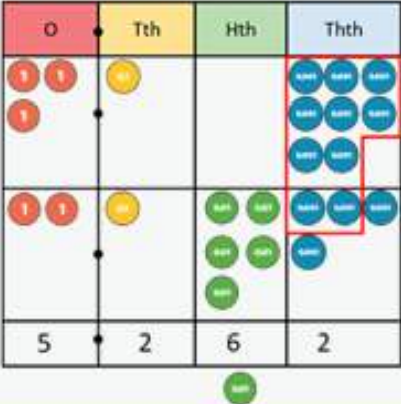
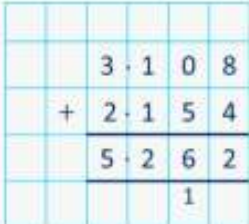
Calculation policy

Mathematics is a subject in which its learning episodes can be taught in multiple different ways, using multiple different methods; this is the case at many schools. This can cause significant confusion and cognitive overload for some students, especially lower attaining students. The purpose of this document is to provide mathematics teachers, teachers of other subjects and staff who support students in mathematics lessons with an easy-reference guide to some the methods that could be employed in the teaching of mathematics. In mathematics we aim to ensure thorough understanding of the subject content covered without relying on process memorisation. The methods outlined are one of the ways of accomplishing this. This document will allow staff to synchronise their practise, to ensure students encounter the same methods throughout their mathematical journey, regardless of their teacher. The aim is that this will provide consistency for students in the long-term and therefore aid in improving their outcomes.

The calculation policy is divided into four sections: addition, subtraction, multiplication and division. At the start of each section, you will find an overview of the progression of skills. Calculations involving decimal numbers and fractions are included. The calculation policy follows the same concrete, pictorial, abstract approach as our main schemes of learning. Where appropriate, sentence stems and key questions are included alongside the key representations.

Addition

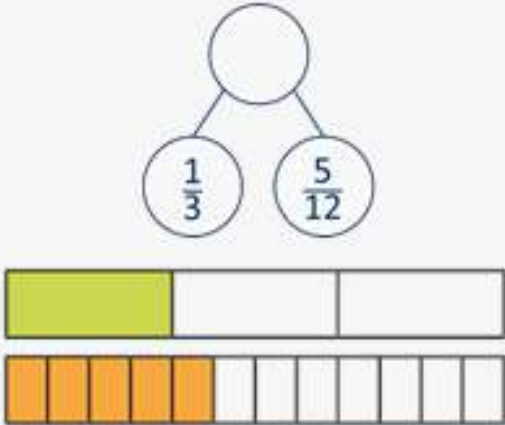
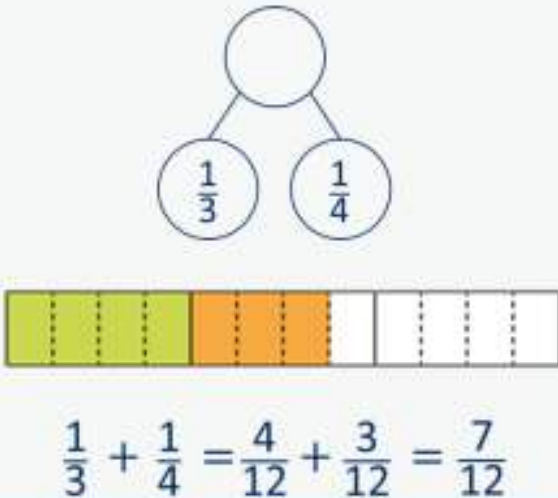
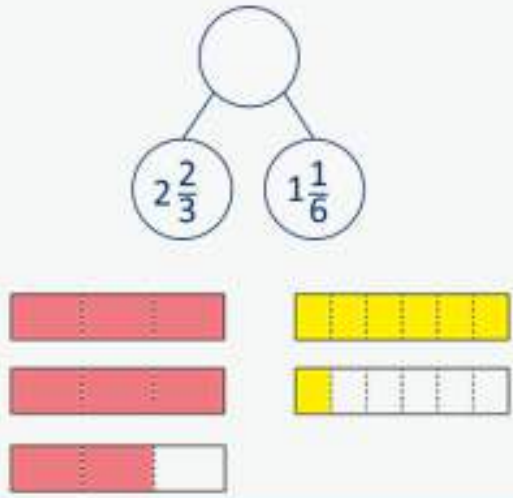
- Add larger numbers, using the formal written method of columnar addition.
- Use their knowledge of the order of operations to carry out calculations involving the 4 operations.
- Calculate intervals across zero.
- Add fractions with different denominators and mixed numbers, using the concept of equivalent fractions.

Progression of skills	Key representations
Add integers up to 10 million Encourage children to estimate and use inverse operations to check answers to calculations.	  
Add decimals with up to 3 decimal places Progress to numbers with digits in different place value columns. Encourage children to check that they have lined up the columns correctly.	I do/do not need to make an exchange because ...   

Addition

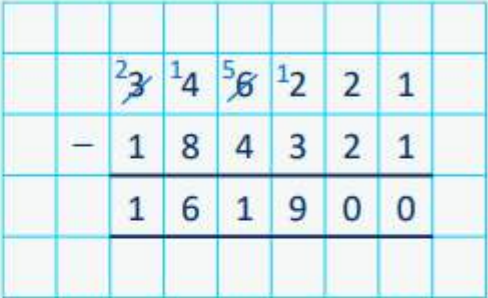
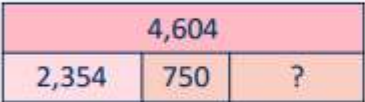
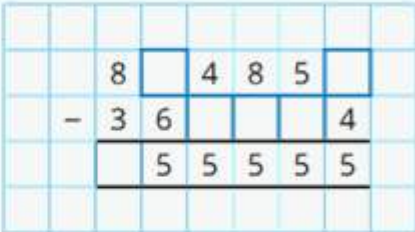
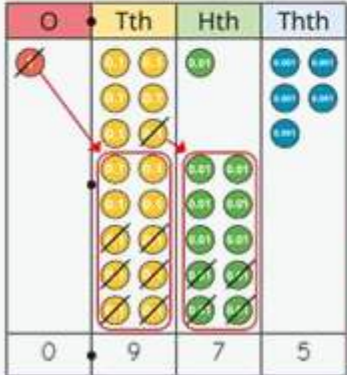
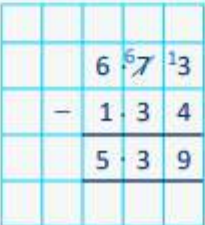
Progression of skills	Key representations
Order of operations Calculations in brackets should be done first. Multiplication and division should be performed before addition and subtraction. *When no brackets are shown and the operations have the same priority, work left to right.	... has greater priority than ..., so the first part of the calculation I need to do is ... A triangle divided into four horizontal sections. From top to bottom: a yellow section with '()', an orange section with 'powers', a purple section with '× and ÷', and a green section with '+ and -'. Two groups of five teal circles each, representing (3 + 4) x 2 = 14. $(3 + 4) \times 2 = 14$ Three teal circles followed by two groups of two teal circles each, representing 3 + 4 x 2 = 11. $3 + 4 \times 2 = 11$ Three groups of two teal circles each, followed by one teal circle, representing 3 x 4 + 2 = 14. $3 \times 4 + 2 = 14$
Negative numbers Children add to negative numbers and carry out calculations which cross 0	... plus ... is equal to ... A number line from -5 to 5. A teal arrow starts at -3 and jumps to the right, passing through -2, -1, 0, and ending at 2. This represents -3 + 5 = 2. $-3 + 5 = 2$ A number line from -11 to 5. A teal arrow starts at -11 and jumps to the right, passing through 0 and ending at 5. A second teal arrow starts at 0 and jumps to the right, passing through 5 and ending at 11. This represents -11 + 16 = 5. $-11 + 16 = 5$ A number line from -5 to 5. Four teal arrows, each of length 1 unit, are drawn between -5 and -1, representing the difference of 4. The difference between -5 and -1 is 4 A number line from -5 to 5. Two teal arrows, each of length 5 units, are drawn between -5 and 5, representing the difference of 10. The difference between -5 and 5 is 10

Addition

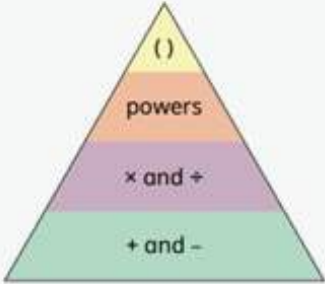
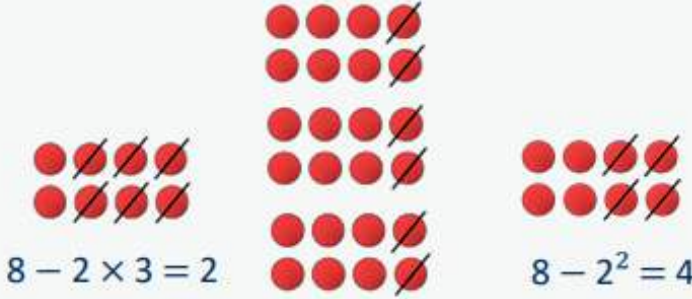
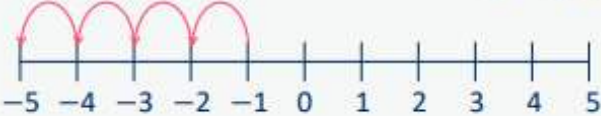
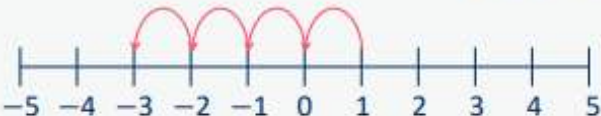
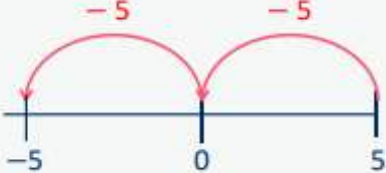
Progression of skills	Key representations		
Add fractions Convert fractions to the same denominator before adding. Progress from fractions where one denominator is a multiple of the other, to any fractions and then to mixed numbers.	The denominator has been multiplied by ..., so the numerator needs to be multiplied by ... 	The lowest common multiple of ... and ... is ...  $\frac{1}{3} + \frac{1}{4} = \frac{4}{12} + \frac{3}{12} = \frac{7}{12}$	...is made up of ... wholes and ... 

Subtraction

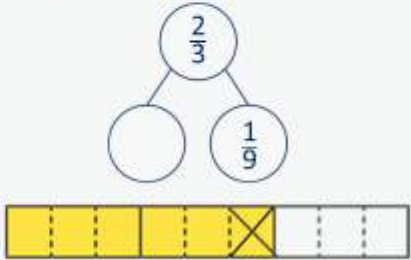
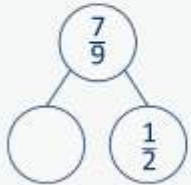
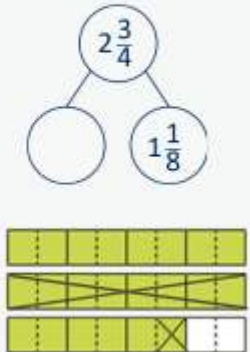
- Subtract larger numbers, using the formal written methods of columnar subtraction.
- Use their knowledge of the order of operations to carry out calculations involving the 4 operations.
- Calculate intervals across zero.
- Subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions.

Progression of skills	Key representations
Subtract integers up to 10 million Encourage children to estimate and use inverse operations to check answers to calculations.	  
Subtract decimals with up to 3 decimal places Progress from the same number of decimal and whole number places to a different number of decimal and whole number places.	I do/do not need to make an exchange because ...   

Subtraction

Progression of skills	Key representations	
Order of operations Children learn the order of priority for operations in a calculation. Calculations in brackets should be done first. Multiplication and division should be performed before addition and subtraction.	... has greater priority than ... , so the first part of the calculation I need to do is ... 	 $8 - 2 \times 3 = 2$ $8 - 2^2 = 4$ $(8 - 2) \times 3 = 18$
Negative numbers Children subtract from positive and negative numbers and calculate intervals across 0	... minus ... is equal to ... $-1 - 4 = -5$  $1 - 4 = -3$ 	 The difference between -5 and -1 is 4  The difference between 5 and -5 is 10

Subtraction

Progression of skills	Key representations		
Subtract fractions Convert fractions to the same denominator before subtracting. Progress from fractions where one denominator is a multiple of the other, to any fractions and then subtracting from a mixed number.	The denominator has been multiplied by ..., so the numerator needs to be multiplied by...  $\frac{2}{3} - \frac{1}{9} = \frac{6}{9} - \frac{1}{9} = \frac{5}{9}$	The lowest common multiple of ... and ... is ...  $\frac{7}{9} - \frac{1}{2} = \frac{14}{18} - \frac{9}{18} = \frac{5}{18}$	... is made up of ... wholes and ...  $2\frac{3}{4} - 1\frac{1}{8} = 1\frac{5}{8}$

Multiplication

- Identify common factors and common multiples.
- Multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication.
- Multiply numbers by 10, 100 and 1,000
- Multiply one-digit numbers with up to two decimal places by whole numbers.
- Use their knowledge of the order of operations to carry out calculations involving the 4 operations.
- Multiply simple pairs of proper fractions, writing the answer in its simplest form.
- Solve problems involving the relative sizes of two quantities where missing values can be found by using integer multiplication and division facts.
- Solve problems involving the calculation of percentages.

Progression of skills	Key representations																																													
Multiply numbers up to 4 digits by a 2-digit number	To multiply by a 2-digit number, first multiply by the ones, then multiply by the tens and then find the total. <table><tr><td></td><td></td><td>1</td><td>2</td><td>0</td><td>7</td><td></td></tr><tr><td></td><td>×</td><td></td><td></td><td>3</td><td>6</td><td></td></tr><tr><td>+</td><td></td><td>7</td><td>2</td><td>4</td><td>2</td><td>(1,207 × 6)</td></tr><tr><td></td><td></td><td>3</td><td>6</td><td>2</td><td>1</td><td>0</td><td>(1,207 × 30)</td></tr><tr><td></td><td></td><td>4</td><td>3</td><td>4</td><td>5</td><td>2</td><td></td></tr><tr><td></td><td></td><td>1</td><td></td><td></td><td></td><td></td><td></td></tr></table>			1	2	0	7			×			3	6		+		7	2	4	2	(1,207 × 6)			3	6	2	1	0	(1,207 × 30)			4	3	4	5	2				1					
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		3	6	2	1	0	(1,207 × 30)																																							
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Multiply by 10, 100 and 1,000 Some children may over-generalise that multiplying by a power of 10 always results in adding zeros.	To multiply by 10/100/1,000, I move all the digits ... places to the left. ... is 10/100/1,000 times the size of ... <table><tr><th>M</th><th>HTh</th><th>TTh</th><th>Th</th><th>H</th><th>T</th><th>O</th></tr><tr><td></td><td></td><td></td><td></td><td>●●</td><td>●●</td><td>●●</td></tr></table> 234 × 10 = 2,340 234 × 100 = 23,400 234 × 1,000 = 234,000 <table><tr><th>Th</th><th>H</th><th>T</th><th>O</th><th>Tth</th><th>Hth</th><th>Thth</th></tr><tr><td></td><td></td><td></td><td></td><td>●●</td><td>●●</td><td>●●</td></tr></table> 0.234 × 10 = 2.34 0.234 × 100 = 23.4 0.234 × 1,000 = 234	M	HTh	TTh	Th	H	T	O					●●	●●	●●	Th	H	T	O	Tth	Hth	Thth					●●	●●	●●																	
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Subtraction

Progression of skills	Key representations	
Order of operations Calculations in brackets should be done first. Multiplication and division should be performed before addition and subtraction.	... has greater priority than ..., so the first part of the calculation I need to do is ... $(3 + 4) \times 2 = 14$ $3 + 4^2 = 19$ $3 + 4 \times 2 = 11$	
Multiply decimals by integers This is the first time children multiply decimals by numbers other than 10, 100 or 1,000. Encourage them to make links with known facts and whole number multiplication.	I know that ... $\times$... = ..., so I also know that ... $\times$... = ... $6 \times 2 = 12$ $6 \times 0.2 = 1.2$	I need to exchange 10 ... for 1 ... $213 \times 4 = 852$ $2.13 \times 4 = 8.52$

Subtraction

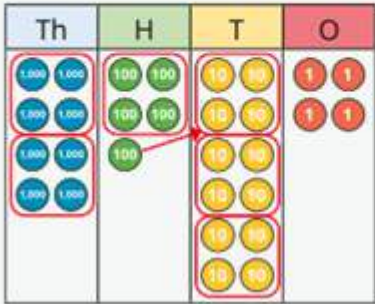
Progression of skills	Key representations	
Multiply fractions by fractions Encourage children to give answers in their simplest form.	When multiplying a pair of fractions, I need to multiply the numerator and multiply the denominator. $\frac{1}{3} \times \frac{1}{5} = \frac{1}{15}$	$\frac{2}{3} \times \frac{4}{5} = \frac{8}{15}$ $\frac{2}{3} \times \frac{3}{5} = \frac{6}{15} = \frac{2}{5}$
Find the whole Children multiply to find the whole from a given part.	If $\frac{1}{\square}$ is ... , then the whole is ... $\times$... $\frac{1}{3}$ of $\underline{\hspace{1cm}}$ = 18 $18 \times 3 = 54$ $\frac{1}{3}$ of 54 = 18	If $\frac{\square}{\square}$ is ... , then $\frac{1}{\square}$ is ... and the whole is ... $\times$... $\frac{4}{9}$ of $\underline{\hspace{1cm}}$ = 48 $\frac{1}{9} = 48 \div 4 = 12$ $9 \times 12 = 108$ $\frac{4}{9}$ of 108 = 48

Subtraction

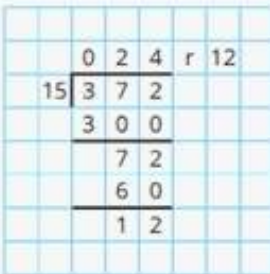
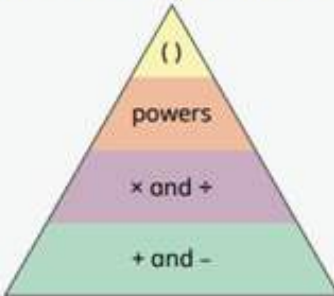
Progression of skills	Key representations																																	
Calculate percentages Children first learn how to find 1%, 10%, 20%, 25% and 50% before using multiples of these amounts to find any percentage.	There are ... lots of ... % in 100% To find ... %, I need to divide by ... <table><tr><td colspan="4">100%</td></tr><tr><td colspan="2">50%</td><td colspan="2">50%</td></tr><tr><td>25%</td><td>25%</td><td>25%</td><td>25%</td></tr></table> 50% of ... = ... ÷ 2 25% of ... = ... ÷ 4	100%				50%		50%		25%	25%	25%	25%	... % is made up of ... %, and ... % <table><tr><td colspan="10">100%</td></tr><tr><td>10%</td><td>10%</td><td>10%</td><td>10%</td><td>10%</td><td>10%</td><td>10%</td><td>10%</td><td>10%</td><td>10%</td></tr></table> To find 30%, I can find 10% and then multiply it by 3 To find 23%, I can use 10% × 2 and 1% × 3 To find 99%, I can find 1%, then subtract from 100%	100%										10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
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Calculations involving ratio Encourage children to see the multiplicative relationship between ratios. They will need to multiply or divide each value by the same number to keep the ratio equivalent. Double number lines and ratio tables help children to see both horizontal and vertical multiplicative relationships.	For every ... , there are ... For every 1 adult on a school trip, there are 6 children. adults <table><tr><td></td></tr></table> children <table><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>								<table><tr><th>Adults</th><th>Children</th></tr><tr><td>1</td><td>6</td></tr><tr><td>2</td><td>12</td></tr><tr><td>3</td><td>18</td></tr></table> The ratio of adults to children is 1 : 6	Adults	Children	1	6	2	12	3	18																	
Adults	Children																																	
1	6																																	
2	12																																	
3	18																																	

Division

- Perform mental calculations, including with mixed operations and large numbers.
- Divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context.
- Divide numbers up to 4 digits by a two-digit number using the formal written method of short division where appropriate, interpreting remainders according to the context.
- Divide numbers by 10, 100 and 1,000 giving answers up to three decimal places.
- Use written division methods in cases where the answer has up to two decimal places.
- Associate a fraction with division and calculate decimal fraction equivalents.
- Divide proper fractions by whole numbers [for example, $\frac{1}{3} \div 2 = \frac{1}{6}$]
- Solve problems involving the calculation of percentages.

Progression of skills	Key representations
Short division Encourage children to interpret remainders in context, for example knowing that “4 remainder 1” could mean 4 complete boxes with 1 left over so 5 boxes will be needed.	There are ... groups of ... hundreds/tens/ones/ in ... I can exchange 1 ... for 10 ...  

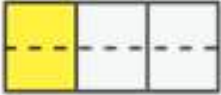
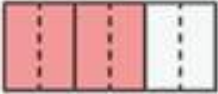
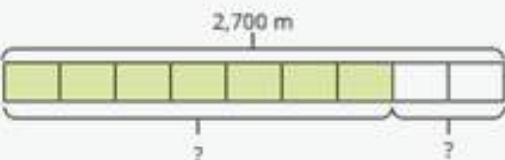
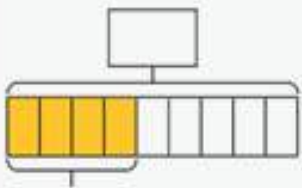
Division

Progression of skills	Key representations	
Mental strategies Include partitioning and number line strategies outlined in Y5 as well as division using factors.	To divide by ... , I can first divide by ... and then divide the answer by ... $240 \div 60 = 240 \div 10 \div 6$ 240 $\rightarrow$ $\div 10$ $\rightarrow$ $\rightarrow$ $\div 6$ $\rightarrow$ $480 \div 24 = 480 \div 4 \div 6$ 480 $\rightarrow$ $\div 4$ $\rightarrow$ $\rightarrow$ $\div 6$ $\rightarrow$	
Long division The long division method is introduced for the first time. Two alternative methods are shown.	Method 1  (12 $\times$ 30) (12 $\times$ 6)  (15 $\times$ 20) (15 $\times$ 4)	Method 2  
Order of operations Calculations in brackets should be done first, then powers. Multiplication and division should be performed before addition and subtraction.	... has greater priority than ..., so the first part of the calculation I need to do is ...   $(6 + 4) \div 2 = 5$  $6 + 4 \div 2 = 8$	

Division

Progression of skills	Key representations																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
Divide by 10, 100 and 1,000 Encourage children to notice that dividing by 100 is the same as dividing by 10 twice, and that dividing by 1,000 is the same as dividing by 10 three times.	To divide by ... , I move the digits ... places to the right. <table><tr><td>H</td><td>T</td><td>O</td><td>Tth</td><td>Hth</td><td>Thth</td></tr><tr><td>●●</td><td>●</td><td>●●</td><td></td><td></td><td></td></tr></table> + 1,000 ↓ <table><tr><td>H</td><td>T</td><td>O</td><td>Tth</td><td>Hth</td><td>Thth</td></tr><tr><td></td><td></td><td></td><td>●●</td><td>●</td><td>●●</td></tr></table> $312 \div 10 = 31.2$ $312 \div 100 = 3.12$ $312 \div 1,000 = 0.312$ $906 \div 10 = 90.6$ $906 \div 100 = 9.06$ $906 \div 1,000 = 0.906$		H	T	O	Tth	Hth	Thth	●●	●	●●				H	T	O	Tth	Hth	Thth				●●	●	●●																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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Division

Progression of skills	Key representations		
Divide a fraction by an integer This is the first time children divide fractions by an integer.	... ones divided by 2 is ... ones so ... sevenths divided by 2 is ... sevenths.  $\frac{4}{7} \div 4 = \frac{1}{7}$  $\frac{4}{7} \div 2 = \frac{2}{7}$	I am dividing by ..., so I can split each part into ... equal parts.  $\frac{1}{3} \div 2 = \frac{1}{6}$	... is equivalent to ... so ... $\div$... = ... $\div$...  $\frac{2}{3} = \frac{4}{6}$ so $\frac{2}{3} \div 4 = \frac{4}{6} \div 4 = \frac{1}{6}$
Fraction of an amount Children divide and multiply to find fractions of an amount. Bar models can still be used to support understanding where needed.	To find $\frac{1}{\square}$ I divide by ... $\frac{1}{2}$ of 36 = $36 \div 2$ $\frac{1}{12}$ of 36 = $36 \div 12$	If $\frac{1}{\square}$ is equal to ..., then $\frac{\square}{\square}$ are equal to ...  $\frac{7}{9}$ of 2,700 = $\frac{1}{9}$ of 2,700 $\times 7$	If $\frac{\square}{\square}$ is equal to ..., then the whole is equal to ...  $\frac{4}{9}$ of ____ = 48

Division

Progression of skills	Key representations																																					
Calculate percentages Children first learn how to find 1%, 10%, 20%, 25% and 50% before using multiples of these amounts to find any percentage.	There are ... lots of ... % in 100% To find ... %, I need to divide by ... <table><tr><td colspan="4">100%</td></tr><tr><td colspan="2">50%</td><td colspan="2">50%</td></tr><tr><td>25%</td><td>25%</td><td>25%</td><td>25%</td></tr></table> 50% of ... = ... ÷ 2 25% of ... = ... ÷ 4	100%				50%		50%		25%	25%	25%	25%	... % is made up of ... %, and ... % <table><tr><td colspan="10">100%</td></tr><tr><td>10%</td><td>10%</td><td>10%</td><td>10%</td><td>10%</td><td>10%</td><td>10%</td><td>10%</td><td>10%</td><td>10%</td></tr></table> To find 30%, I can find 10% and then multiply it by 3 To find 23%, I can use 10% × 2 and 1% × 3 To find 99%, I can find 1%, then subtract from 100%	100%										10%	10%	10%	10%	10%	10%	10%	10%	10%	10%				
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Calculations involving ratio Encourage children to see the multiplicative relationship between ratios. They will need to multiply or divide each value by the same number to keep the ratio equivalent. Double number lines and ratio tables help children to see both horizontal and vertical multiplicative relationships.	For every ... , there are ... For every 6 children on a school trip, there is 1 adult. adults <table><tr><td></td></tr></table> children <table><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> <table><tr><th>Adults</th><th>Children</th></tr><tr><td>1</td><td>6</td></tr><tr><td>2</td><td>12</td></tr><tr><td>3</td><td>18</td></tr></table> <table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>Adults</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Children</td><td>6</td><td>12</td><td>18</td><td></td><td></td><td></td></tr></table> The ratio of children to adults is 6 : 1									Adults	Children	1	6	2	12	3	18	0	1	2	3	4	5	6	Adults							Children	6	12	18			
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