



Heptonstall Primary School

Calculation Policy Year 5 and 6



This booklet contains the calculation methods used in year 5 and 6 for each of the four operations – addition, subtraction, multiplication and division.

Please use this document as a tool to support your child at home. The methods we use in school may or may not be familiar to you. Children can become confused when they seek support from an adult at home because often, the adult will teach the method they themselves were taught.

Knowing how the methods in this booklet work will help you to help your child. All staff in school use this document so that we can ensure consistency in our approach.

Year 5



Year 5

UPPER KEY STAGE 2

Children move on from dealing mainly with whole numbers to performing arithmetic operations with both decimals and fractions. By the end of year 6, pupils should be fluent in written methods for all four operations, including long multiplication and division, and in working with fractions, decimals and percentages.

Addition and subtraction: Children will consolidate their use of written procedures in adding and subtracting whole numbers with up to 6 digits and also decimal numbers with up to 3 decimal places. Mental strategies for adding and subtracting increasingly large numbers will also be taught. These will draw upon children’s robust understanding of place value and knowledge of number facts. Negative numbers will be added and subtracted.

Multiplication and division: Efficient and flexible strategies for mental multiplication and division are taught and practised, so that children can perform appropriate calculations even when the numbers are large, such as $40\,000 \times 6$ or $40\,000 \div 8$. In addition, it is in Years 5 and 6 that children extend their knowledge and confidence in using written algorithms for multiplication and division.

Fractions, decimals and percentages: Fractions and decimals are also added, subtracted, divided and multiplied, within the bounds of children’s understanding of these more complicated numbers. Children will also calculate percentages and ratios.

	National Curriculum Objectives	Mental Calculation	Written Calculation- including concrete, pictorial and abstract methods																														
Y5 +	<p>Add whole numbers with more than 4 digits, including using formal written methods</p> <p>Add numbers mentally with increasingly large numbers</p>	<p>Simple mental addition to ensure no errors with column addition.</p> <p>Use of place value to find 10, 100,</p>	<p>Column method for addition including regrouping.</p> <p>Children will be working with place value of numbers up to 1,000,000 in year 5 and will continue to build upon the column addition skills they have worked on in Y4 by calculating with numbers with more than 4 digits.</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="border: 1px solid black; padding: 2px;">4</td> <td style="border: 1px solid black; padding: 2px;">5</td> <td style="border: 1px solid black; padding: 2px;">8</td> <td style="border: 1px solid black; padding: 2px;">6</td> <td style="border: 1px solid black; padding: 2px;">4</td> <td rowspan="5" style="padding-left: 10px;"> Starting with the ones, add each column in turn. Regroup tens, hundreds, thousands, ten thousands as required. </td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">+</td> <td style="border: 1px solid black; padding: 2px;">2</td> <td style="border: 1px solid black; padding: 2px;">3</td> <td style="border: 1px solid black; padding: 2px;">4</td> <td style="border: 1px solid black; padding: 2px;">9</td> <td style="border: 1px solid black; padding: 2px;">7</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;">6</td> <td style="border: 1px solid black; padding: 2px;">9</td> <td style="border: 1px solid black; padding: 2px;">3</td> <td style="border: 1px solid black; padding: 2px;">6</td> <td style="border: 1px solid black; padding: 2px;">1</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;"></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> <td style="border: 1px solid black; padding: 2px;"></td> </tr> </table> <p>Children will also use this method to add numbers that have up to 3 decimal places</p> <p>N.B. Children are given problems which involve adding numbers with differing place value and involving whole numbers added to numbers with decimal places. We teach children to use place holders to help them to line their digits up with the correct place value.</p>	4	5	8	6	4	Starting with the ones, add each column in turn. Regroup tens, hundreds, thousands, ten thousands as required.	+	2	3	4	9	7		6	9	3	6	1			1	1	1							
4	5	8	6	4	Starting with the ones, add each column in turn. Regroup tens, hundreds, thousands, ten thousands as required.																												
+	2	3	4	9		7																											
	6	9	3	6		1																											
		1	1	1																													

N.B. Children are encouraged to put their regrouped digit wherever they feel suits them best. They are shown different ways and are allowed to choose

N.B. Children are given problems which involve adding numbers with differing place value and involving whole numbers added to numbers with decimal places. We teach children to use place holders to help them to line their digits up with the correct place value.

1,000, 10,000, 100,000 or 1,000,000 more.

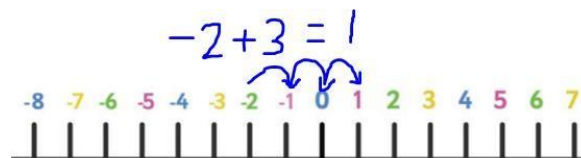
Negative numbers

Find 12 more than -8. Children to use a number line to start with and then use counting through 0 to support with this type of calculation e.g. -8 to 0 = 8. $0 + 4 = 4$.

Number bonds

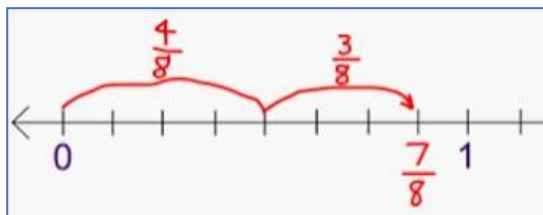
Have a focus on quick and accurate recall of number bonds to 100 (in tens and ones) and to 1000 (in hundreds and tens) and be able to apply these to larger numbers e.g. $51 + 49 = 100$ so $510 + 490 = 1000$ and therefore $5100 + 4900 = 10,000$ etc.

Add fractions with the same denominator and denominators that are multiples of the same number

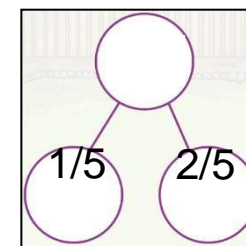
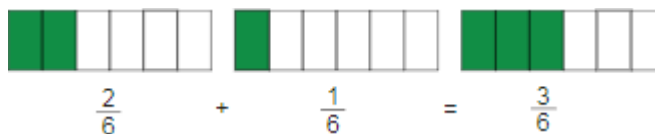


Adding fractions with the same denominator

Children are taught using a range of different models. They are taught to count in fractions and use number lines to add fractions of the same denominator.



They are also taught addition of fractions using the bar model.



These pictorial representations demonstrate that when adding fractions of the same denominator, only the numerators are added and the denominator stays the same. The children can then use a more abstract method as shown.

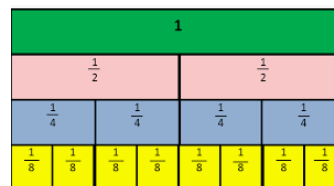
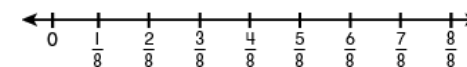
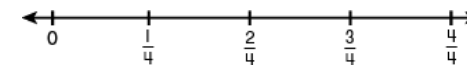
$$\frac{2}{9} + \frac{5}{9} = \frac{7}{9}$$

Adding Fractions with denominators that are multiples of the same number.

Children are taught to use their knowledge of equivalent fractions to convert the fractions to the same denominator before adding them.

For example, $4/8 + 1/4$

First they would convert $4/8$ to $2/4$ at first using pictorial representations (bar model, number line, fraction wall etc) and then the more abstract way of multiplying the numerator and denominator by the same number.



Then they would add the numerators together $2/4 + 1/4 = 3/4$

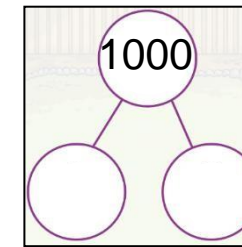
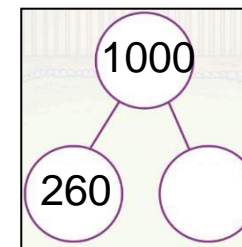
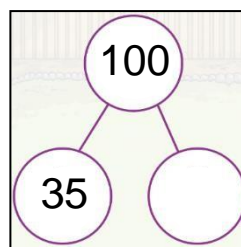
Subtract numbers mentally with increasingly large numbers

Number bonds

Have a focus on quick and accurate recall of number bonds to 100 (in tens and ones) and to 1000 (in hundreds and tens) and be able to apply these to larger numbers e.g. $100 - 49 = 51$ so $1,000 - 490 = 510$ and therefore $10,000 - 4900 = 5,100$ etc.

Compensating and bridging

Children are taught to use rounding to support with the mental calculation of subtracting larger numbers e.g. $4,000 - 1998$. Children are to round to the



Part whole models can be used to help children see the relationship between number bonds

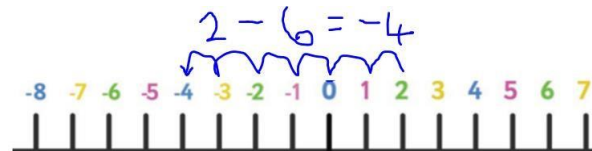
Subtract whole numbers with more than 4 digits, including using formal written methods

Subtract fractions with the same denominator and denominators that are multiples of the same number

nearest ten, hundred, thousand, ten thousand, hundred thousand dependent on the calculation.
 $4,000 - 1998$ would be $4,000 - 2,000$ and then the two would need to be added back on.

Negative numbers

Find 12 less than 8. Children to use a number line to start with and then use counting through 0 to support with this type of calculation e.g. $8 - 8 = 0$ and $0 - 4$ leftover = -4



Column method for subtraction including exchanging.

Children will be working with numbers up to 1,000,000 in year 5 and will continue to build upon the column subtraction skills they have worked on in Y4 by calculating with numbers with more than 4 digits.

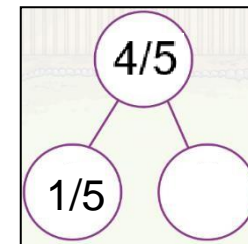
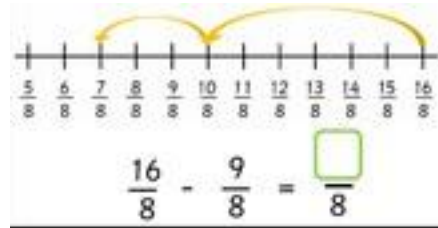
	3	5	6	13	12
-		3	4	7	6
	3	2	2	6	6

Starting with the ones, subtract each column in turn.
 Exchange tens, hundreds, thousands and/or ten thousands as required.

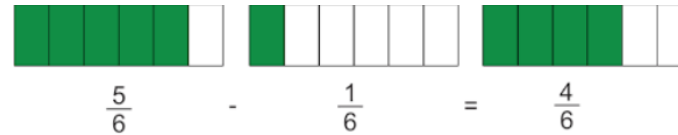
Children will also use this method to subtract numbers that have up to 3 decimal places

Subtracting fractions with the same denominator.

Children are taught using a range of different models. They are taught to count in fractions and use number lines to add fractions of the same denominator.



They are also taught subtraction of fractions using the bar model and also represent it using part-whole models.

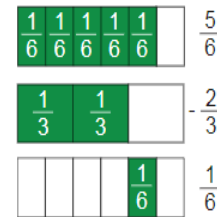


These pictorial representations demonstrate that when subtracting fractions of the same denominator, only the numerators are subtracted and the denominator stays the same. The children can then use a more abstract method as shown.

$$\frac{7}{8} - \frac{2}{8} = \frac{5}{8}$$

Subtracting Fractions with denominators that are multiples of the same number

Children are taught to use their knowledge of equivalent fractions to convert the fractions to the same denominator before subtracting them.



For this they would first recognise that 2/3 is equivalent to 4/6 and then subtract 4/6 from 5/6.

Children will use pictorial representations to support them with calculations. E.g. number lines, bar models and fraction walls.

Multiply numbers mentally drawing upon known facts

Children will be taught to build upon their rapid recall of 1-12 x multiplication facts, and multiplication facts for multiples of 10 and 100 to calculate an increasing range of multiplication questions mentally. E.g. if they know 3x4 they can work out 30x4, 0.3x4 etc.

Multiply a 2 or 3 digit number by a single digit by partitioning– e.g. 26 x 3 = 20 x 3 + 6 x 3

$$\begin{aligned} 6 \times 204 &= 6 \times 200 + 6 \times 4 \\ &= 1,200 + 24 \\ &= 1,224 \end{aligned}$$

Y5
x

Multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit number

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

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

Long Multiplication method

Children have been introduced to the formal written method of short multiplication for 2 or 3 digit numbers multiplied by one digit in year 4. This will be recapped prior to extending to long multiplication (see Yr 4 policy).

1	5	4	
1	5	4	
×	2	6	
	9	2	4
3	0	8	0
4	0	0	4
1	1		

Start with the ones.
 $154 \times 6 = 924$
 $154 \times 20 = 3080$
 $3080 + 924 = 4004$

N.B. Children are encouraged to use different colour pens for each line of working out if they struggle. See diagram for example of how colour can be used to show which digit the lines of working out relate to.

Multiplication by 10, 100 and 1000

M	Hth	Tth	Th	H	T	O	t	h	th
Millions	Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	Ones	Tenths	Hundredths	Thousandths
1 000 000	100 000	10 000	1000	100	10	1	0.1	0.01	0.001
						5	6		
					5	6			

N.B. We continue to reiterate here that children **cannot** simply add a zero. When we work with numbers with decimal places, this becomes really apparent as the place value doesn't change, e.g. 5.6 is the same value as 5.60. The example in the table demonstrates the correct working for multiplying 5.6 by 10.

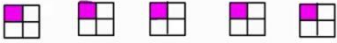
Children are provided with a laminated version of this grid to practise moving the digits when multiplying by 10, 100 and 1000. The majority of children will move on to drawing their own grid on their whiteboard in their book to support their calculations and then to complete the calculations mentally.

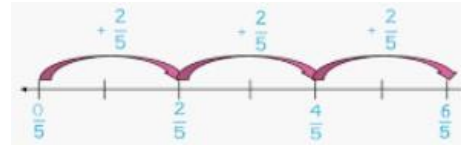
- Move 1 place to the left for x 10
- Move 2 places to the left for x 100
- Move 3 places to the left for x 1000

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

diagrams

diagrams

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


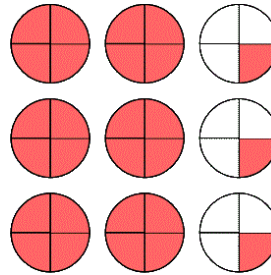


$$1 \frac{1}{4} = 1 \frac{1}{4}$$

Children are provided with visual representation to show how to multiply fractions. They are also taught how to convert an answer from an improper fraction to a mixed number as shown above.

Number lines are used to show the repeated addition method for multiplying fractions.

Multiply mixed numbers by whole numbers



Children are provided with visual representation to show how to multiply mixed numbers by whole numbers. They calculate using images to begin with.

They are taught the following more abstract steps.

1. Convert the mixed number into an improper fraction.
2. Multiply the numerator by the whole number.
3. Convert the answer back into a mixed number by dividing the numerator by the denominator. The remainder is represented as a fraction.

$$2 \frac{1}{4} \times 3 = \frac{9}{4} \times 3 = \frac{27}{4}$$

$$\frac{27}{4} \times 3 = \frac{27}{4}$$

$$27 \text{ divided by } 4 = 6 \text{ r}3$$

$$6 \frac{3}{4}$$

Divide numbers mentally drawing upon known facts

Children will be taught to build upon their rapid recall of 1-12 x division facts, and dividing and multiplying by 10 and 100 to calculate an increasing range of division questions mentally. E.g. if they know 12 divided by 3 =4 they can work out 12 divided by 0.3= 40

Divide numbers up to 4 digits by a one-digit number using the formal written method of short

Y5
÷

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

Divide whole numbers and those involving decimals by 10, 100 and 1000

division

'Bus Stop Division' has been introduced in year 4 with 3 digit dividends and a single digit divisor with no remainders. This will be the first step in year 5. They will then move on to 3 digit dividends with single digit divisor with remainders. Finally, they will work with 4 digit dividends.

Begin with divisions that divide equally with no remainder.

$$\begin{array}{r} 218 \\ 4 \overline{) 872} \\ \underline{8} \\ 7 \\ \underline{7} \\ 2 \\ \underline{2} \\ 0 \end{array}$$

Move onto divisions with a remainder.

$$\begin{array}{r} 86 \text{ r } 2 \\ 5 \overline{) 432} \\ \underline{4} \\ 3 \\ \underline{3} \\ 2 \\ \underline{0} \\ 2 \end{array}$$

$$\begin{array}{r} 0663 \text{ r } 5 \\ 8 \overline{) 535029} \\ \underline{40} \\ 13 \\ \underline{8} \\ 50 \\ \underline{40} \\ 10 \\ \underline{8} \\ 29 \end{array}$$

Interpreting remainders

Children will be taught how to interpret remainders from division questions and whether they should round to the next whole number or not. They will be taught to read questions carefully, underlining key words/phrases e.g. full boxes, how many do they need, how many ... can be bought?

Division by 10, 100 and 1000

M Millions 1 000 000	Hth Hundred Thousands 100 000	Tth Ten Thousands 10 000	Th Thousands 1 000	H Hundreds 100	T Tens 10	O Ones 1	t Tenths 0.1	h Hundredths 0.01	th Thousandths 0.001
				5	6	0			
						5.6			

Children are provided with a laminated version of this grid to practise moving the digits when dividing by 10, 100 and 1000. The majority of children will move on to drawing their own grid on their whiteboard in their book to support their calculations and then to complete the calculations mentally.

N.B. We continue to reiterate here that children **cannot** simply remove zeros. Many of the numbers the children work with aren't multiples of 10 or 100 so they need to have the concept of the digits moving on the place value grid.

Move 1 place to the right for $\div 10$

Move 2 places to the right for $\div 100$

Move 3 places to the right for $\div 1000$

Year 6



Year 6

UPPER KEY STAGE 2

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Addition and subtraction: Children will consolidate their use of written procedures in adding and subtracting whole numbers with up to 6 digits and also decimal numbers with up to 3 decimal places. Mental strategies for adding and subtracting increasingly large numbers will also be taught. These will draw upon children's robust understanding of place value and knowledge of number facts. Negative numbers will be added and subtracted.

Multiplication and division: Efficient and flexible strategies for mental multiplication and division are taught and practised, so that children can perform appropriate calculations even when the numbers are large, such as $40\,000 \times 6$ or $40\,000 \div 8$. In addition, it is in Years 5 and 6 that children extend their knowledge and confidence in using written algorithms for multiplication and division.

Fractions, decimals and percentages: Fractions and decimals are also added, subtracted, divided and multiplied, within the bounds of children's understanding of these more complicated numbers. Children will also calculate percentages and ratios.

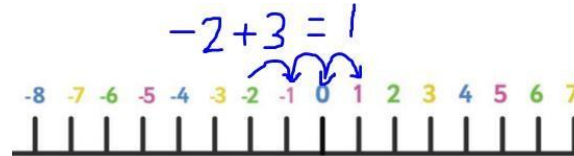
	National Curriculum Objectives	Mental Calculation	Written Calculation- including concrete, pictorial and abstract methods																																																																				
Y6 +	Undertake mental calculations with increasingly large numbers and more complex calculations	<p>Have a focus on quick and accurate recall of number bonds to 100 (in ones and fives) and to 1000 (in hundreds and tens) and be able to apply these to larger numbers e.g. $51+49=100$ so $510 + 490 = 1000$ and therefore $5100 + 4900 = 10,000$ etc.</p> <p>Encourage children to look for ways to simplify problems e.g.</p> <p>Money: $\pounds 8.99 + \pounds 3.49 = \pounds 12.48$ Use $\pounds 9 + \pounds 3.50 = \pounds 12.50$ and subtract 2p</p>	<p>Column method for addition including regrouping.</p> <p>Children will be working with place value of numbers up to 10,000,000 in year 6 and will continue to build upon the column addition skills they have worked on in Y5 by calculating with numbers up to 6 digits</p> <table style="display: inline-table; border-collapse: collapse;"> <tr><td></td><td>4</td><td>5</td><td>8</td><td>6</td><td>4</td></tr> <tr><td>+</td><td>2</td><td>3</td><td>4</td><td>9</td><td>7</td></tr> <tr style="border-top: 1px solid black;"><td></td><td>6</td><td>9</td><td>3</td><td>6</td><td>1</td></tr> <tr><td></td><td></td><td>1</td><td>1</td><td>1</td><td></td></tr> </table> <p>Starting with the ones, add each column in turn. Regroup tens, hundreds, thousands, ten thousands as required.</p> <table style="display: inline-table; border-collapse: collapse;"> <tr><td></td><td>7</td><td>8</td><td>9</td><td>9</td><td>4</td></tr> <tr><td>+</td><td></td><td>6</td><td>7</td><td>4</td><td>3</td></tr> <tr style="border-top: 1px solid black;"><td></td><td></td><td>8</td><td>5</td><td>7</td><td>3</td></tr> <tr><td></td><td>1</td><td></td><td></td><td></td><td></td></tr> </table> <div style="border: 1px solid green; padding: 5px; margin-top: 10px;"> <p>N.B. Children are encouraged to put their regrouped digit wherever they feel suits them best. They are shown different ways and are allowed to choose</p> </div> <p>Children will also use this method to add numbers that have up to 3 decimal places</p> <div style="border: 1px solid green; padding: 5px; margin-top: 10px;"> <p>N.B. Children are given problems which involve adding numbers with differing place value and involving whole numbers added to numbers with decimal places. We teach children to use place holders to help them to line their digits up with the correct place value.</p> </div> <div style="text-align: right; margin-top: 10px;"> <table style="border-collapse: collapse;"> <tr><td>—</td><td>5</td></tr> <tr><td>—</td><td>4</td></tr> <tr><td>—</td><td>3</td></tr> <tr><td>—</td><td>2</td></tr> <tr><td>—</td><td>1</td></tr> <tr><td>—</td><td>0</td></tr> <tr><td>—</td><td>-1</td></tr> <tr><td>—</td><td>-2</td></tr> <tr><td>—</td><td>-3</td></tr> <tr><td>—</td><td>-4</td></tr> </table> </div>		4	5	8	6	4	+	2	3	4	9	7		6	9	3	6	1			1	1	1			7	8	9	9	4	+		6	7	4	3			8	5	7	3		1					—	5	—	4	—	3	—	2	—	1	—	0	—	-1	—	-2	—	-3	—	-4
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Use negative numbers in context and calculate intervals across zero.

Children will be taught to count on from a negative number up through zero in ones and to do this with problems in context.

Calculating negative numbers pictorially-

Children are encouraged to draw number lines to help them to calculate intervals through zero. They are shown number lines both horizontally and vertically, also in context using thermometers. They can then use these number lines to make 'jumps' as they have done in previous year groups so help them to see the changes as they cross zero.



Add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions

Use common factors to simplify fractions mentally

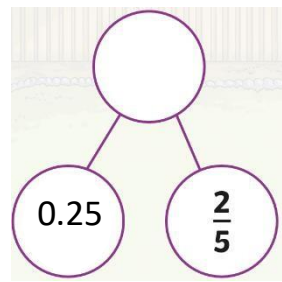
Adding fractions

Children are taught to change the fractions to an alternate equivalent fraction so that they both have the same denominator, add the numerators and then simplify or change to a mixed number if needed e.g. When adding mixed numbers, we teach the children these two methods.

$\frac{4}{5} + \frac{3}{4}$
 ↓ ↓
 $\frac{16}{20} + \frac{15}{20} = \frac{31}{20}$ → convert from an improper fraction to a mixed number
 $= 1\frac{11}{20}$
 (Lowest common denominator = 20)

$1\frac{3}{4} + 2\frac{2}{6}$ change to improper fractions
 ↓ ↓
 $\frac{7}{4} + \frac{14}{6}$ (lowest common denominator = 12)
 $\frac{21}{12} + \frac{28}{12} = \frac{49}{12} \rightarrow 4\frac{1}{12}$

$1\frac{3}{4} + 2\frac{2}{6}$ Add the whole numbers first
 $1 + 2 = 3$
 Then add the fractions
 $\frac{3}{4} + \frac{2}{6}$ (lowest common denominator = 12)
 $\frac{9}{12} + \frac{4}{12} = \frac{13}{12} \rightarrow 1\frac{1}{12}$
 Add them all together
 $3 + 1\frac{1}{12} = 4\frac{1}{12}$



Use of the part-whole model for adding fractions, decimals and percentages

			<p>Children have use part-whole models all through school. We use them in many different contexts in year 6, here is one example- we use them to get the children to practise converting decimals, fractions and percentages to the same thing and then adding them. They choose the best way to convert before adding.</p> <div data-bbox="1742 252 2047 411" style="border: 1px solid black; padding: 5px; display: inline-block;"> $\frac{1}{\square} + \frac{\square}{9} = \frac{\square}{36}$ </div> <p>Missing number problems are used to help support reasoning and problem solving</p>																		
<p>Y6 -</p>	<p>Use negative numbers in context and calculate intervals across zero.</p> <p>Subtract fractions with</p>	<p>Children will be taught to <u>count back</u> through zero in ones and to do this with problems in context.</p> <p>Use common factors to simplify fractions</p>	<p>Calculating negative numbers pictorially- Children are encouraged to draw number lines to help them to calculate intervals through zero. They are shown number lines both horizontally and vertically, also in context using thermometers. They can then use these number lines to make 'jumps' as they have done in previous year groups so help them to see the changes as they cross zero.</p> <div data-bbox="1720 555 2114 772" style="text-align: center;"> </div> <p>Column method for subtraction including exchanging. Children will be working with numbers up to 10,000,000 in year 6 and will continue to build upon the column subtraction skills they have worked on in Y5 by calculating with numbers containing up to 6 digits</p> <table border="1" data-bbox="875 922 1155 1066" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td>3</td> <td>5</td> <td>6</td> <td>13</td> <td>12</td> </tr> <tr> <td>-</td> <td></td> <td>3</td> <td>4</td> <td>7</td> <td>6</td> </tr> <tr> <td></td> <td>3</td> <td>2</td> <td>2</td> <td>6</td> <td>6</td> </tr> </table> <p>Starting with the ones, subtract each column in turn. Exchange tens, hundreds, thousands and/or ten thousands as required.</p> <div data-bbox="1518 912 2042 1120" style="border: 2px solid green; padding: 10px; margin-left: auto; margin-right: auto;"> <p>N.B. Children are also exposed to tricky calculations where the larger number is a multiple of 10,000 so they have to use and apply their knowledge of exchanging to solve it.</p> </div> <p>Subtracting Fractions</p>		3	5	6	13	12	-		3	4	7	6		3	2	2	6	6
	3	5	6	13	12																
-		3	4	7	6																
	3	2	2	6	6																

different denominators and mixed numbers, using the concept of equivalent fractions

mentally

Children are taught to change the fractions to an alternate equivalent fraction so that they both have the same denominator, subtract the numerators and then simplify or change to a mixed number if needed e.g.

$$\frac{4}{5} - \frac{3}{4} = \frac{16}{20} - \frac{15}{20} = \frac{1}{20}$$

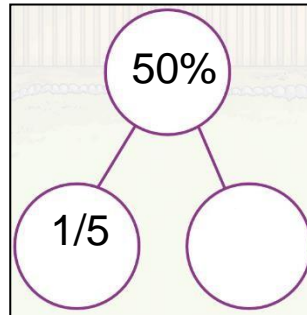
Lowest common denominator = 20

When subtracting with mixed numbers, we teach the children to convert the mixed numbers to improper fractions first and then subtract as they can't always subtract the whole numbers first.

$$3\frac{1}{4} - 2\frac{4}{6} = \frac{13}{4} - \frac{16}{6} = \frac{39}{12} - \frac{32}{12} = \frac{7}{12}$$

Lowest common denominator = 12

Use of the part-whole model for subtracting fractions, decimals and percentages



Children have use part-whole models all through school. We use them in many different contexts in year 6, here is one example- we use them to get the children to practise converting decimals, fractions and percentages to the same thing and then subtracting them. They choose the best way to convert before subtracting.

Perform mental calculations, including with mixed operations and large numbers

Encourage children to think about the order in which they calculate, e.g.

Order of calculations:
 $50 \times 34 \times 2 = 50 \times 2 \times 34 = 100 \times 34 = 3400$

Long Multiplication method

1	5	4	
×		2	6
	9	2	4
3	0	8	0
4	0	0	4
1	1		

Start with the ones.

$154 \times 6 = 924$

$154 \times 20 = 3080$

$3080 + 924 = 4004$

N.B. This method has been introduced in year 5 so they should be familiar with it. We focus on SATs style arithmetic questions and making sure children check their working by repeating the calculation to check they get the same answer or doing the inverse.

N.B. Children are encouraged to use different colour pens for each line of working out if they struggle. See diagram for example of how colour can be used to show which digit the lines of working out relate to.

124 × 26 becomes

	1	2	
	1	2	4
×		2	6
	7	4	4
	2	4	8
	3	2	2
	1	1	

Answer: 3224

Y6
x

Multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long

multiplication

Multiply simple pairs of proper fractions, writing the answer in its simplest form

Identify the value of each digit in numbers given to three decimal places and multiply numbers by 10, 100 and 1000

Multiplying Fractions

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

Multiply the numerators together, multiply the denominators together, simplify or change to a mixed number if needed

Children will also multiply proper fractions by whole numbers. We teach the children to change the whole number to become a fraction over 1 and multiply as if they were two fractions. E.g.

N.B. Children are taught that **of** and **x** are interchangeable in these types of calculations e.g. $2/5 \times 3$ is the same as $2/5$ **of** 3

We use bar models and diagrams like the ones above to support the teaching of this. The bar model and diagrams support the repeated addition of the fractional parts.

Multiplication by 10, 100 and 1000

M	Hth	Tth	Th	H	T	O	t	h	th
Millions 1 000 000	Hundred Thousands 100 000	Ten Thousands 10 000	Thousands 1000	Hundreds 100	Tens 10	Ones 1	Tenths 0.1	Hundredths 0.01	Thousandths 0.001
						5	6		
						5	6		

Children are provided with a laminated version of this grid to practise moving the digits when multiplying by 10, 100 and 1000. The majority of children will move on to drawing their own grid on their whiteboard in their book to support their calculations and then to complete the calculations mentally.

- Move 1 place to the left for x10
- Move 2 places to the left for x100
- Move 3 places to the left for x1000

N.B. We continue to reiterate here that children **cannot** simply add a zero. When we work with numbers with decimal places, this becomes really apparent as the place value doesn't change, e.g. 5.6 is the same value as 5.60. The example in the table demonstrates the correct working

	<p>giving answers up to three decimal places</p> <p>Multiply one-digit numbers with up to two decimal places by whole numbers</p> <p>Use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.</p>	<p>Children will often use estimation to check the reliability of their answers for multiplication and division. We encourage children to estimate the answers first by rounding, so 3.19×12, they would round the decimal number to the nearest whole, $3 \times 12 = 36$. They also need to check that their decimal point in their answer box lines up with the one in the question.</p>	<p>Short and long multiplication of one-digit numbers with up to two decimal places and whole numbers</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> $\begin{array}{r} 3.19 \times 8 \\ \times 8 \\ \hline 25.52 \\ 17 \end{array}$ </div> <div style="text-align: center;"> $\begin{array}{r} 3.19 \times 12 \\ \times 12 \\ \hline 6.38 \\ 31.90 \\ \hline 38.28 \\ 1 \end{array}$ </div> </div> <p>Children will use the same method of short or long multiplication as they would with whole numbers and will also use place value to make sure the digits are lined up correctly.</p> <p>Children can use multiplication facts to help them e.g.</p> <div style="border: 1px solid black; background-color: #e0f2f1; padding: 5px; margin: 10px auto; width: fit-content;"> $0.05 \times 32 = 1.6$ $5 \times 32 = 160$ $0.5 \times 32 = 16$ </div> <p>Children can also multiply the number out to get a whole number and work the calculation through, then divide the answer by the same amount.</p> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> $\begin{array}{r} 3.19 \times 8 \\ \downarrow \\ \times 100 = 319 \\ \times 8 \\ \hline 2552 \rightarrow \div 100 = 25.52 \\ 17 \end{array}$ </div>
<p>Y6</p> <p>\div</p>	<p>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</p>	<p>Perform mental calculations, including with mixed operations and large numbers</p> <p>Children are encouraged to use their knowledge of division facts to help them with calculating with larger numbers e.g. For $5400 \div 6$, they can use $54 \div 6 = 9$</p>	<p>Long Division- Chunking</p> <p>In year 6, children are taught to show remainders of division calculations as fractions or decimals.</p> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> $\begin{array}{r} 432 \div 15 \\ 15 \overline{) 432} \\ \underline{300} \\ 132 \\ \underline{120} \\ 12 \\ \hline \end{array}$ <div style="display: inline-block; border: 1px solid black; padding: 5px; margin: 5px;"> Fact Box $15 \times 1 = 15$ $15 \times 2 = 30$ $15 \times 20 = 300$ $15 \times 4 = 60$ $15 \times 8 = 120$ </div> <p>$= 28 \frac{12}{15} \rightarrow 28 \frac{4}{5}$ or 28.8</p> </div> <p>Children create a fact box for the divisor. They don't need to include every multiple of that number, only ones that are relevant to the calculation. It is sometimes easier to create the fact box as they are going along. These chunks are then subtracted from the dividend until they can no longer remove a whole chunk or get to zero. Any amount left over is the remainder. This remainder then needs to be interpreted as a fraction or decimal.</p>

the context

540÷6=90
So 5400÷6=900

Use written division methods in cases where the answer has up to two decimal places

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

Identify the value of each digit in numbers given to three decimal places and divide numbers by 10, 100 and 1000 giving answers up to three decimal place

Short Division

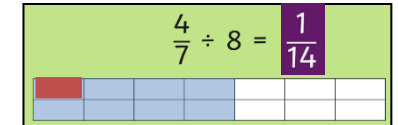
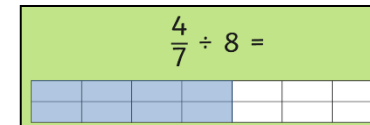
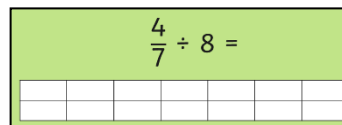
Handwritten short division showing 15 dividing 432.0 to get 28.8. The quotient is written as 028.8 with a zero in the tens place. The dividend is written as 432.0 with place value markers: 4^h, 3^t, 2^o, 0¹⁰.

Children may still choose to create a fact box depending on the size of the dividend and divisor. They use the short method of division starting from the highest value digit in the divisor. If the child is interpreting the remainder as a decimal, they will need to use a place holder after the decimal point and continue to divide. They can also interpret their remainder as a fraction.

		4	4	0	5
12	5	5	2	4	6

Divide proper fractions by whole numbers

We begin by using bar models and diagrams to show how the fraction is divided



Once the children understand how the fractional part is divided, we use an abstract method to allow them to reach the answer more quickly and efficiently.

1. Keep the numerator the same
2. Multiply the denominator by the whole number to become the new denominator
3. Simplify if needed

An abstract method showing the division of 4/7 by 8. The fraction 4/7 is circled in blue. An arrow points to the result 1/14, where the denominator 7 has been multiplied by 8 to become 56, and the numerator 4 has been simplified to 1.

Division by 10, 100 and 1000



Children are provided with a laminated version of this grid to practise moving the digits when dividing by 10, 100 and 1000. The majority of children will move on to drawing their own grid on their whiteboard in their book to support their calculations and then to complete the calculations mentally.

Move 1 place to the right for ÷10
Move 2 places to the right for ÷100
Move 3 places to the right for ÷1000

N.B. We continue to reiterate here that children **cannot** simply remove zeros. Many of the numbers the children work with aren't multiples of 10 or 100 so they need to have the concept of the digits moving on the place value grid

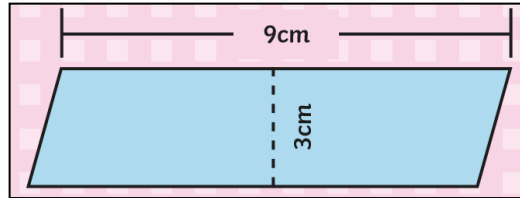
	Associate a fraction with division and calculate decimal fraction equivalents		<p>Relating division to fractions</p> <p>Show children that the division symbol is actually very similar to a fraction but without numbers as numerator and denominators.</p> <p>Children need to understand that fractions are related to division e.g. $\frac{1}{2}$ is the same as $1 \div 2$</p> <div style="border: 1px solid black; padding: 10px; margin-top: 10px;"> $\frac{3}{8} = 8 \overline{) 3.375}$ $\frac{1}{2} = 2 \overline{) 1.0} \quad \frac{1}{5} = 5 \overline{) 0.2}$ </div>																		
	Use their knowledge of the order of operations to carry out calculations involving the four operations (BODMAS)		<table border="1" style="border-collapse: collapse; width: 100%;"> <tr> <td style="background-color: #e0f0ff;">B</td> <td style="background-color: #e0f0ff;">Brackets</td> <td style="background-color: #e0f0ff;">$10 \times (4 + 2) = 10 \times 6 = 60$</td> </tr> <tr> <td style="background-color: #e0f0ff;">O</td> <td style="background-color: #e0f0ff;">Order</td> <td style="background-color: #e0f0ff;">$5 + 2^2 = 5 + 4 = 9$</td> </tr> <tr> <td style="background-color: #e0f0ff;">D</td> <td style="background-color: #e0f0ff;">Division</td> <td style="background-color: #e0f0ff;">$10 + 6 \div 2 = 10 + 3 = 13$</td> </tr> <tr> <td style="background-color: #e0f0ff;">M</td> <td style="background-color: #e0f0ff;">Multiplication</td> <td style="background-color: #e0f0ff;">$10 - 4 \times 2 = 10 - 8 = 2$</td> </tr> <tr> <td style="background-color: #e0f0ff;">A</td> <td style="background-color: #e0f0ff;">Addition</td> <td style="background-color: #e0f0ff;">$10 \times 4 + 7 = 40 + 7 = 47$</td> </tr> <tr> <td style="background-color: #e0f0ff;">S</td> <td style="background-color: #e0f0ff;">Subtraction</td> <td style="background-color: #e0f0ff;">$10 \div 2 - 3 = 5 - 3 = 2$</td> </tr> </table> <div style="border: 2px solid green; padding: 5px; margin-top: 10px; width: fit-content;"> <p>N.B. The O in BODMAS is also referred to as 'of' as in 'powers of' and an I for indices.</p> </div> <p>Pupils explore the order of operations using brackets; for example, $2 + 1 \times 3 = 5$ and $(2 + 1) \times 3 = 9$.</p>	B	Brackets	$10 \times (4 + 2) = 10 \times 6 = 60$	O	Order	$5 + 2^2 = 5 + 4 = 9$	D	Division	$10 + 6 \div 2 = 10 + 3 = 13$	M	Multiplication	$10 - 4 \times 2 = 10 - 8 = 2$	A	Addition	$10 \times 4 + 7 = 40 + 7 = 47$	S	Subtraction	$10 \div 2 - 3 = 5 - 3 = 2$
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%	Solve problems involving the calculation of percentages [for example, of measures, and such as 15% of 360] and the use of percentages for comparison		<p>The Bubble Method</p> <p>To find a percentage of any number:</p> <p>Children fill in the value of each circle, beginning with the main number in the shaded area. They then work their way through all 6 circles by following the actions on each arrow. They can then use the information in each circle to find any percentage.</p> <p>e.g. 76% of 800, you would add</p> <p>50%= 400 25%=200 1%=8 76% = 608</p>																		

			<p>Divide by 100 and then multiply by the percentage</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> $76\% \text{ of } 800$ $800 \div 100 = 8$ $8 \times 76 = 608$ $\begin{array}{r} 76 \\ \times 8 \\ \hline 608 \\ 4 \end{array}$ </div> <p style="text-align: right;"><i>(if it easier to do so- some values it wouldn't make sense to do this)</i></p> <div style="border: 1px solid green; padding: 5px; margin-bottom: 10px;"> <p>N.B. Children are taught all 4 methods and then they choose the method that they are most comfortable with to solve calculations</p> </div> <p>Multiply by the percentage and divide by 100</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> $\begin{array}{r} 800 \\ \times 76 \\ \hline 4800 \\ 56000 \\ \hline 60800 \end{array} \rightarrow \div 100 = 608$ </div> <div style="border: 1px solid black; padding: 5px;"> $76\% \text{ of } 800 = 800\% \text{ of } 76$ $\text{So } 8 \text{ lots of } 76 = 608$ </div>
Shape and Measure	Convert between miles and kilometres		<div style="border: 1px solid pink; padding: 10px; text-align: center; margin-bottom: 10px;"> 5 miles \approx 8 kilometres </div> <p>Children are taught that 1 mile is approximately 1.6km. The whole number equivalent is 5 miles approximately equals 8km.</p> <p>Miles to Kilometres- Multiply by 8 then divide by 5 Kilometres to miles- Multiply by 5 then divide by 8</p> <p>Alternatively, children can multiply or divide by 1.6 if they are confident.</p>

Calculate the area of parallelograms and triangles

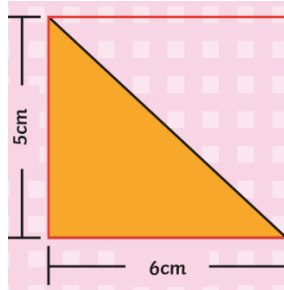
Area of parallelograms and triangles

Area of a parallelogram = length \times perpendicular height



$$9\text{cm} \times 3\text{cm} = 27\text{cm}^2$$

Area of a triangle = (base \times height) \div 2



$$6\text{cm} \times 5\text{cm} = 30\text{cm} \div 2 = 15\text{cm}^2$$