

Didsbury C of E Primary School,

Draft Mathematics Calculation Policy

Overview of calculation strategies

Early Years into KS1

Practical, oral and mental activities to understand calculation.

Personal methods of recording.

Key Stage 1

Methods of recording / jottings to support calculation (e.g. partitioning)

Introduce signs and symbols (**+ / - in Year 1 and \times / \div in Year 2**)

Use images such as empty number lines to support mental and informal calculation.

Year 3

More efficient informal written methods / jottings – expanded methods and efficient use of number lines. Standard method of vertical addition where appropriate.

Years 4-6

Continue using efficient mental methods, jottings, number lines and informal methods where appropriate. Develop these to larger numbers and decimals where appropriate.

Develop efficient written methods (standard / compact methods) for all four operations. The new curriculum says that schools have flexibility over when to introduce standard methods, as long as they are introduced by the end of the key stage. Please note the year group labelled at the side of each method.

When faced with a calculation, children are able to decide which method is most appropriate and have strategies to check its accuracy.

Whatever method is chosen (in any year group), it must still be underpinned by a secure and appropriate knowledge of number facts

By the end of Year 6, children should:

- have a secure knowledge of number facts and a good understanding of the four operations in order to:
 - carry out calculations mentally when using one-digit and two-digit numbers
 - use particular strategies with larger numbers when appropriate
- use notes and jottings to record steps and part answers when using longer mental methods
- **have an efficient, reliable, compact written method of calculation for each operation that children can apply with confidence when undertaking calculations that they cannot carry out mentally;**

Children should always **look at the actual numbers (not the size of the numbers)** before attempting any calculation to determine whether or not they need to use a written method.

Therefore, the key question that children should always ask themselves before attempting a calculation is: -

Can I do it in my head?

Mental methods of calculation

Oral and mental work in mathematics is essential, particularly so in calculation. Early practical, oral and mental work must lay the foundations by providing children with a good understanding of how the four operations build on efficient counting strategies and a secure knowledge of place value and number facts. Later work must ensure that children recognise how the operations relate to one another and how the rules and laws of arithmetic are to be used and applied. Ongoing oral and mental work provides practice and consolidation of these ideas. It must give children the opportunity to apply what they have learned to particular cases, exemplifying how the rules and laws work, and to general cases where children make decisions and choices for themselves.

The ability to calculate mentally forms the basis of all methods of calculation and has to be maintained and refined. A good knowledge of numbers or a 'feel' for numbers is the product of structured practice and repetition. It requires an understanding of number patterns and relationships developed through directed enquiry, use of models and images and the application of acquired number knowledge and skills. Secure mental calculation requires the ability to:

- recall key number facts instantly – for example, all addition and subtraction facts for each number to at least 10 (Year 2), sums and differences of multiples of 10 (Year 3) and multiplication facts up to 12×12 (Year 4);
- use taught strategies to work out the calculation – for example, recognise that addition can be done in any order and use this to add mentally a one-digit number or a multiple of 10 to a one-digit or two-digit number (Year 1), partition two-digit numbers in different ways including into multiples of ten and one and add the tens and ones separately and then recombine (Year 2), when applying mental methods in special cases (Year 5);
- understand how the rules and laws of arithmetic are used and applied – for example, to add or subtract mentally combinations of one-digit and two-digit numbers (Year 3), and to calculate mentally with whole numbers and decimals (Year 6).

Written methods for addition of whole numbers

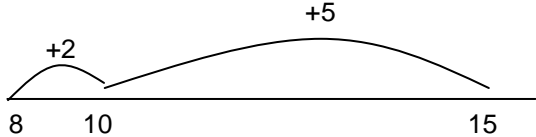
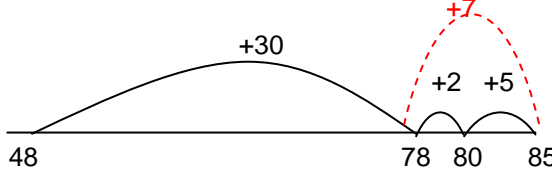
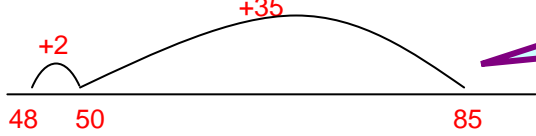
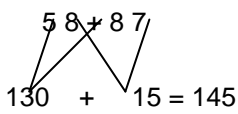
The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use an efficient written method accurately and with confidence.

Children need to acquire **one efficient written method of calculation for** addition which they know they can rely on **when mental methods are not appropriate**.

To add successfully, children need to be able to:

- recall all addition pairs to $9 + 9$ and complements in 10;
- add mentally a series of one-digit numbers, such as $5 + 8 + 4$;
- add multiples of 10 (such as $60 + 70$) or of 100 (such as $600 + 700$) using the related addition fact, $6 + 7$, and their knowledge of place value;
- partition two-digit and three-digit numbers into multiples of 100, 10 and 1 in different ways.

Note: It is important that children's mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for addition.

Year group	Main method	Alternative method(s)
	Stage 1: The empty number line	Partition one of the numbers
Year 2 / 3	<p>Steps in addition can be recorded on a number line. The steps often bridge through a multiple of 10. $8 + 7 = 15$</p>  <p>$48 + 37 = 85$</p>  <p>Alternatives (for some children)</p> <p>$48 + 37 = 85$</p> 	<p>This method will be a jotting approach, and may look like the following examples: -</p> <p>$48 + 37$</p> <p>$48 + 30 = 78$ $78 + 7 = 85$</p> <p>Or</p> <p>$48 + 30 + 7 = 85$</p> <div style="border: 2px solid purple; border-radius: 50%; padding: 10px; display: inline-block; margin-top: 20px;"> <p><i>Using a number line lets me show my thinking on paper</i></p> </div>
Year group	Main method	Alternative method(s)
	Stage 2: Partitioning	Partition one of the numbers
Year 2 / 3	<p>Record steps in addition using partitioning: Initially as a jotting: -</p> <p>$58 + 87 = 50 + 80 + 8 + 7 = 130 + 15 = 145$</p> <p>Or</p> <p>$50 + 80 = 130$ $8 + 7 = 15$ $130 + 15 = 145$</p> <p>Partitioned numbers are then written under one another: -</p> $\begin{array}{r} 50 \quad 8 \\ 80 \quad 7 \\ \hline 130 \quad 15 = 145 \end{array}$ <p>This method may be appropriate for some children with larger numbers if they struggle with Stages 3-4</p> <p>$500 \quad 30 \quad 8 \quad 2400 \quad 60 \quad 7$ $\underline{200 \quad 80 \quad 6} \quad \underline{700 \quad 80 \quad 5}$ $700 \quad 110 \quad 14 = 824 \quad 3100 \quad 140 \quad 12 = 3252$</p>	<p>$58 + 87$</p> <div style="border: 2px solid purple; border-radius: 50%; padding: 10px; display: inline-block; margin-top: 20px;"> <p><i>This method is basically a 'jotting' version of the number line method</i></p> </div> <p>Or</p> <p>$87 + 50 = 137 \quad 58 + 80 = 138$ $137 + 8 = 145 \quad 138 + 7 = 145$</p> <p>Or</p> <p>$87 + 50 + 8 = 145$</p> <p>One popular jotting approach is: -</p> 

Stage 3: Expanded method in columns

Year 3

A. Single 'carry' in units

B. 'Carry' in units and tens

Adding the tens first: -

$$67 + 24$$

$$\begin{array}{r} 67 \\ + 24 \\ \hline 80 \\ \underline{11} \\ 91 \end{array}$$

$$58 + 87$$

$$\begin{array}{r} 58 \\ + 87 \\ \hline 130 \\ \underline{15} \\ 145 \end{array}$$

'Fifty plus eighty equals one hundred and thirty, because 'five plus eight equals thirteen.'

Year 3

Adding the ones first:

$$\begin{array}{r} 67 \\ + 24 \\ \hline 11 \\ \underline{80} \\ 91 \end{array}$$

$$\begin{array}{r} 58 \\ + 87 \\ \hline 15 \\ \underline{130} \\ 145 \end{array}$$

Adding the ones first gives the same answer as adding the tens first

Refine over time to adding the ones digits first consistently, with harder calculations

$$457 + 76$$

$$538 + 286$$

$$\begin{array}{r} 457 \\ + 76 \\ \hline 13 \\ 120 \\ \underline{400} \\ 533 \end{array}$$

Then

$$\begin{array}{r} 538 \\ + 286 \\ \hline 14 \\ 110 \\ \underline{700} \\ 824 \end{array}$$

The time spent practising expanded method will depend on security of number facts recall and understanding of place value.

Stage 4: Column method

Year 3 onwards

$$58 + 87$$

$$457 + 76$$

$$538 + 286$$

Record carry digits above the line

$$\begin{array}{r} 58 \\ + 87 \\ \hline \underline{11} \\ 145 \end{array}$$

Then

$$\begin{array}{r} 457 \\ + 76 \\ \hline \underline{11} \\ 533 \end{array}$$

Then

$$\begin{array}{r} 538 \\ + 286 \\ \hline \underline{11} \\ 824 \end{array}$$

Use the words 'carry ten' and 'carry hundred', not 'carry one'

Once confident, use with larger whole numbers and decimals.

Return to expanded if children make repeated errors

Years 4-6

$$2467 + 785$$

$$4824 + 2369$$

$$46.73 + 78.6$$

$$\begin{array}{r} 2467 \\ + 785 \\ \hline \underline{11} \\ 2252 \end{array}$$

$$\begin{array}{r} 4824 \\ + 2369 \\ \hline \underline{11} \\ 7193 \end{array}$$

$$\begin{array}{r} 46.73 \\ + 78.60 \\ \hline \underline{111} \\ 125.33 \end{array}$$

Written methods for subtraction of whole numbers

The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use an efficient written method accurately and with confidence.

To subtract successfully, children need to be able to:

- recall all addition and subtraction facts to 20;
- subtract multiples of 10 (such as $160 - 70$) using the related subtraction fact, $16 - 7$, and their knowledge of place value;
- partition two-digit and three-digit numbers into multiples of one hundred, ten and one in different ways (e.g. partition 74 into $70 + 4$ or $60 + 14$).

Note: *It is important that children's mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for subtraction.*

Children need to acquire **one efficient written method of calculation** for subtraction which they know they can rely on **when mental methods are not appropriate**.

But, they should look at the actual numbers each time they see a calculation and decide whether or not their favoured method is most appropriate (e.g. If there are zeroes in a calculation such as $2006 - 128$ then the 'counting up' approach may well be the best method in that particular instance

Therefore, when subtracting, whether mental or written, children will mainly choose between two main strategies: -

Taking away (Counting Back)

Complementary Addition (Counting up)

When should we count back and when should we count up?

This will alter depending on the calculation (see below), but often the following rules apply

If the numbers are far apart, or there isn't much to subtract ($278 - 24$) then count back.

If the numbers are close together ($206 - 188$), then count up

In many cases, either strategy would be suitable

Year group	Subtraction by counting back (or taking away)	Subtraction by counting up (or complementary addition)
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Stage 1: Using the empty number line

The empty number line helps to record or explain the steps in mental subtraction. It is an ideal model for **counting back** and **bridging ten**, as the steps can be shown clearly. It can also show **counting up** from the smaller to the larger number to **find the difference**,

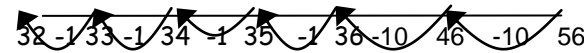
Year 1/2 Y2 The steps often bridge through a multiple of 10.

$13 - 8 = 5$

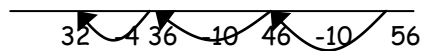


Year 2/3

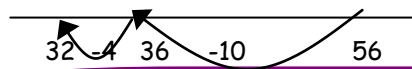
For 2 digit numbers, count back in 10s and 1s
 $56 - 24 = 32$



Then subtract the units in a single jump

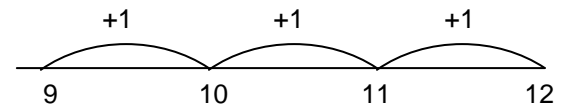


Then subtract tens and units in single jumps



Y1 Small differences can be found by counting up

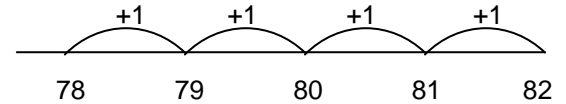
$12 - 9 = 3$



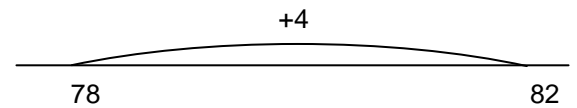
For 2 (or 3) digit numbers close together, count up

$82 - 78 = 4$

First, count in ones



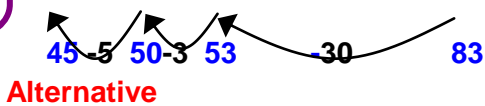
Then, use number facts to count in a single jump



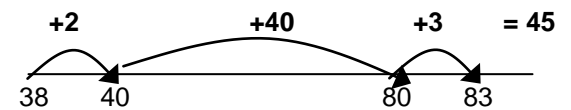
Some numbers (83 - 38) can be subtracted just as quickly either way.

$83 - 38 = 45$

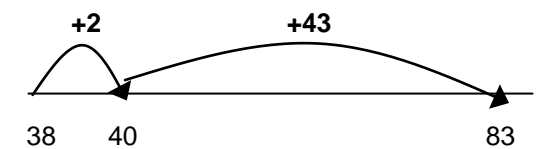
Partition 38.
 Take away 30
 then take away 8 (-3 -5)



Count up from the smaller to the larger number.



or



	Stage 2: Subtraction by counting back Expanded method	Subtraction by counting up Number lines (continued)
Year 3	<p>Introduce the expanded method with 3 digit numbers, when children can calculate mentally with 2 digit numbers. This is not a natural follow on from mental strategies.</p> <p>Exchange from hundreds to tens and tens to ones 142 - 86</p> $\begin{array}{r} 100 \ 40 \ 2 \\ - \quad 80 \ 6 \\ \hline \end{array}$ $\begin{array}{r} 100 \ 30 \ 12 \\ - \quad 80 \ 6 \\ \hline \end{array}$ $\begin{array}{r} 100 \ 40 \ 2 \\ - \quad 80 \ 6 \\ \hline 50 \ 6 \end{array}$	<p>142 - 86</p> <p>86 $\xrightarrow{+4}$ 90 $\xrightarrow{+10}$ 100 $\xrightarrow{+40}$ 140 $\xrightarrow{+2}$ 142 = 56</p> <p>Or (in fewer steps)</p> <p>86 $\xrightarrow{+14}$ 100 $\xrightarrow{+42}$ 142 = 56</p>
Year 3/4	<p>Subtract the ones then the tens then the hundreds Demonstrate without exchanging first</p> <p>A 784 - 351</p> $\begin{array}{r} 700 \ 80 \ 4 \\ - 300 \ 50 \ 1 \\ \hline 400 \ 30 \ 3 \end{array}$ <p>B Move towards exchanging from hundreds to tens and tens to ones</p> <p>854 - 286</p> $\begin{array}{r} 800 \ 50 \ 4 \\ - 200 \ 80 \ 6 \\ \hline 600 \ 70 \ 8 \end{array}$ $\begin{array}{r} 800 \ 50 \ 4 \\ - 200 \ 80 \ 6 \\ \hline 500 \ 60 \ 8 \end{array}$ <p>C Use some examples which include the use of zeros</p> <p>605 - 328</p> $\begin{array}{r} 600 \ 0 \ 5 \\ - 300 \ 20 \ 8 \\ \hline \end{array}$ $\begin{array}{r} 500 \ 90 \ 1 \\ - 300 \ 20 \ 8 \\ \hline \end{array}$	<p>854 - 286</p> <p>286 $\xrightarrow{+4}$ 290 $\xrightarrow{+10}$ 300 $\xrightarrow{+500}$ 800 $\xrightarrow{+54}$ 854 = 568</p> <p>Or (the efficient method)</p> <p>286 $\xrightarrow{+14}$ 300 $\xrightarrow{+554}$ 854 = 568</p> <p>Alternative (count the hundreds first)</p> <p>286 $\xrightarrow{+100}$ 386 $\xrightarrow{+100}$ 486 $\xrightarrow{+100}$ 586 $\xrightarrow{+100}$ 686 $\xrightarrow{+100}$ 786 $\xrightarrow{+14}$ 800 $\xrightarrow{+54}$ 854 = 568</p> <p>For numbers containing zeros, counting up is often the most reliable</p> <p>328 $\xrightarrow{+72}$ 400 $\xrightarrow{+205}$ 605 = 277</p>

Continue to use expanded subtraction until both number facts and place value are considered to be very secure

Stage 3: Standard method (decomposition)

Y4 onwards

Decomposition relies on secure understanding of the expanded method, and simply displays the same numbers in a contracted form.

(Using example B from Stage 2)

854 – 286

$$\begin{array}{r} \cancel{7} \quad \cancel{14} \quad \cancel{1} \\ 8 \quad 5 \quad 4 \\ - 2 \quad 8 \quad 6 \\ \hline 5 \quad 6 \quad 8 \end{array}$$

Continue to refer to digits by their actual value, not their digit value, when explaining a calculation. E.g. One hundred and forty subtract eight.

Again, use examples containing zeros, remembering that it may be easier to count on with these numbers (see Stage 2)

(Using example C from Stage 2)

605 – 328

$$\begin{array}{r} \cancel{5} \quad \cancel{9} \quad \cancel{1} \\ 6 \quad 0 \quad 5 \\ - 3 \quad 2 \quad 8 \\ \hline 2 \quad 7 \quad 7 \end{array}$$

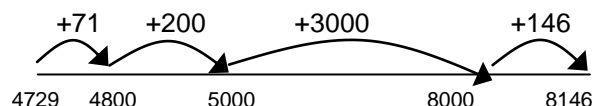
The counting up method is often used in Years 5 and 6 for children whose mental recall is weak, or who require a visual image to support their thinking.

Move onto examples using 4 digit (or larger) numbers and then onto decimal calculations.

8146 – 4729

$$\begin{array}{r} \cancel{7} \quad \cancel{1} \quad \cancel{3} \quad \cancel{1} \\ 8 \quad 1 \quad 4 \quad 6 \\ - 4 \quad 7 \quad 2 \quad 9 \\ \hline 3 \quad 4 \quad 1 \quad 7 \end{array}$$

8146 – 4729



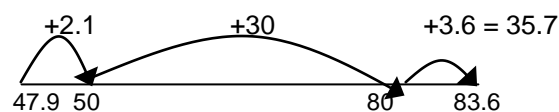
$$\begin{array}{r} = 3000 \\ 146 \\ 200 \\ \hline 71 \\ \hline 3417 \end{array}$$

Both methods can be used with decimals, although the counting up method becomes less efficient and reliable when calculating with more than two decimal places.

83.6 – 47.9

$$\begin{array}{r} \cancel{7} \quad \cancel{12} \quad \cancel{1} \\ 8 \quad 3 \quad 6 \\ - 4 \quad 7 \quad 9 \\ \hline 3 \quad 5 \quad 7 \end{array}$$

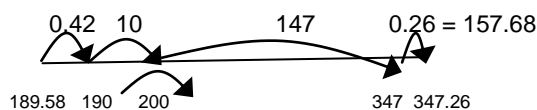
83.6 – 47.9



347.26 – 189.58

$$\begin{array}{r} \cancel{1} \quad \cancel{13} \quad \cancel{16} \quad \cancel{11} \quad \cancel{1} \\ 3 \quad 4 \quad 7 \quad 2 \quad 6 \\ - 1 \quad 8 \quad 9 \quad 5 \quad 8 \\ \hline 1 \quad 5 \quad 7 \quad 6 \quad 8 \end{array}$$

347.26 – 189.58



Written methods for multiplication of whole numbers

The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use an efficient written method accurately and with confidence.

These notes show the stages in building up to using an efficient method for two-digit by one-digit multiplication by the end of Year 4, two-digit by two-digit multiplication by the end of Year 5, and three-digit by two-digit multiplication by the end of Year 6.

To multiply successfully, children need to be able to:

- recall all multiplication facts to 12×12 ;
- partition number into multiples of one hundred, ten and one;
- work out products such as 70×5 , 70×50 , 700×5 or 700×50 using the related fact 7×5 and their knowledge of place value;
- add two or more single-digit numbers mentally;
- add multiples of 10 (such as $60 + 70$) or of 100 (such as $600 + 700$) using the related addition fact, $6 + 7$, and their knowledge of place value;
- add combinations of whole numbers using the column method (see above).

Note:

Children need to acquire **one efficient written method of calculation for** multiplication which they know they can rely on **when mental methods are not appropriate.**

It is important that children's mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for multiplication.

These mental methods are often more efficient than written methods when multiplying.

Use partitioning and grid methods until number facts and place value are secure

For a calculation such as 25×24 , a quicker method would be 'there are four 25s in 100 so $25 \times 24 = 100 \times 6 = 600$ '

When multiplying a 2 digit x 3 digit number (or a 3 digit x 3 digit number), the standard method is usually the most efficient

At all stages, use known facts to find other facts. E.g. Find 7×8 by using 5×8 (40) and 2×8 (16)

Expanded multiplication

Year group Stage 1: Number lines and mental methods

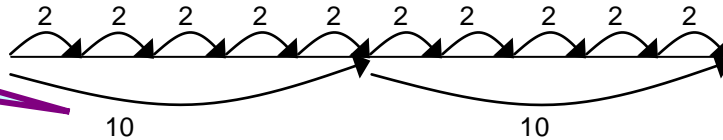
Year 1/2

Begin by building on the understanding that multiplication is repeated addition, using arrays and number lines to support the thinking.

Using a number line

$$2 \times 10 = 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2$$

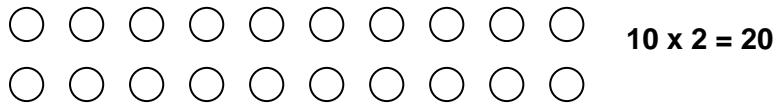
$$10 \times 2 = 10 + 10$$



$$2 \times 10 = 10 \times 2$$

AND

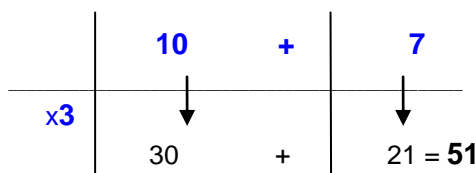
Using an array



$$2 \times 10 = 20$$

Year 3

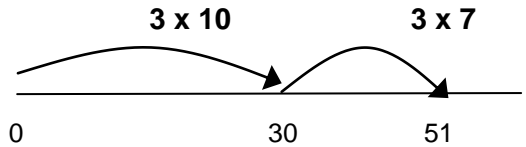
Extend the above methods to include the 3, 4 and 6 times tables then begin to partition using jottings and number lines.



$$3 \times 17$$



becomes

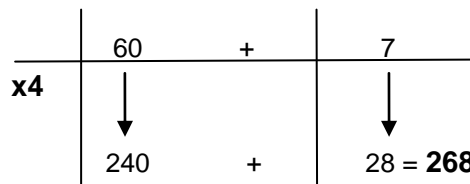


Or

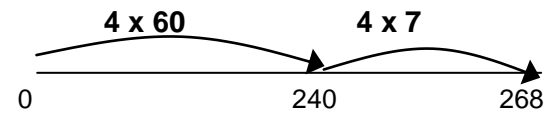
$$\begin{array}{r} 10 \times 3 = 30 \\ 7 \times 3 = \underline{21} \\ 51 \end{array}$$

Extend the methods above to calculations which give products greater than 100.

Years 3-4



$$4 \times 67$$



Or

$$\begin{array}{r} 60 \times 4 = 240 \\ 7 \times 4 = \underline{28} \\ 268 \end{array}$$

Each of these methods can be used in the future if children find expanded or standard methods difficult

Extend to using these methods with all tables to 10 x 10.

Year group	Stage 2: Written methods – Short multiplication																																																																																																									
	Grid multiplication	Vertical multiplication (Expanded method into standard)																																																																																																								
Late Year 3 onwards (Mainly Year 4)	<p>The grid method of multiplication is a simple, alternative way of recording the jottings shown previously.</p> <p>3 x 17</p> <table style="margin-left: 40px;"> <tr> <td></td> <td style="text-align: center;">10</td> <td style="text-align: center;">7</td> <td></td> </tr> <tr> <td style="border-right: 1px solid black; border-bottom: 1px solid black; padding: 5px;">3</td> <td style="border-right: 1px solid black; border-bottom: 1px solid black; padding: 5px; text-align: center;">30</td> <td style="border-bottom: 1px solid black; padding: 5px; text-align: center;">21</td> <td style="padding: 5px;">= 51</td> </tr> </table> <p>If necessary (for some children) it can initially be taught using an array to show the actual product.</p> <table style="margin-left: 40px;"> <tr> <td style="border-right: 1px solid black; border-bottom: 1px solid black; padding: 5px;">x</td> <td style="border-bottom: 1px solid black; padding: 5px; text-align: center;">10</td> <td style="border-bottom: 1px solid black; padding: 5px; text-align: center;">7</td> <td></td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">3</td> <td style="padding: 5px; text-align: center;">30</td> <td style="padding: 5px; text-align: center;">21</td> <td></td> </tr> </table>		10	7		3	30	21	= 51	x	10	7		3	30	21		<p>The expanded method links the grid method to the standard method.</p> <p>It still relies on partitioning the tens and units, but sets out the products vertically.</p> <p>Children will use the expanded method until they can securely use and explain the standard method.</p> <div style="border: 2px solid purple; border-radius: 15px; padding: 10px; margin-top: 10px; background-color: #e0ffff;"> <p>When setting out calculations vertically, begin with the units first (as with addition and subtraction)</p> </div>																																																																																								
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E.g. 4 multiplied by 70, not 7</p> </div>		67		x 4	28	→		240			268			67		x 4	28			240			268			89		x 7	63	→		560			623			89		x 7	623			560			623			378		x 4	32	→		280			1200			1512			378		x 4	1512			280			1200			1512	
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Stage 3: Long multiplication: TU x TU

Year group	Grid long multiplication	Vertical 'standard' long multiplication																															
<p>Years 4/5</p>	<p>Extend the grid method to TU x TU, asking children to estimate first. ‘</p> <p>38 x 57</p> <p>38 x 57 is approximately 40 x 60 = 2400.</p> <table style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <tr> <td style="border-right: 1px solid black; padding: 5px;">x</td> <td style="border-right: 1px solid black; padding: 5px;">50</td> <td style="border-right: 1px solid black; padding: 5px;">7</td> <td style="border: none;"></td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">30</td> <td style="border-right: 1px solid black; padding: 5px;">1500</td> <td style="border-right: 1px solid black; padding: 5px;">210</td> <td style="padding: 5px;">1 7 1 0</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">8</td> <td style="border-right: 1px solid black; padding: 5px;">400</td> <td style="border-right: 1px solid black; padding: 5px;">56</td> <td style="padding: 5px;">4 5 6</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;"></td> <td style="border-right: 1px solid black; padding: 5px;"></td> <td style="border-right: 1px solid black; padding: 5px;"></td> <td style="padding: 5px;">2 1 6 6</td> </tr> </table> <p style="text-align: center; margin-top: 5px;">1</p> <div style="border: 2px solid purple; border-radius: 15px; padding: 10px; width: fit-content; margin: 10px auto;"> <p><i>Add the two products in each row</i></p> </div> <div style="border: 2px solid purple; border-radius: 15px; padding: 10px; width: fit-content; margin: 10px auto;"> <p><i>Add these sums for the overall product</i></p> </div> <p>The grid method is often the ‘choice’ of many children in Years 5 and 6, and is the method that they will mainly use for long multiplication.</p>	x	50	7		30	1500	210	1 7 1 0	8	400	56	4 5 6				2 1 6 6	<p>Children should only use the ‘standard’ method of long multiplication if they can regularly get the correct answer using this method.</p> <p>38 x 57</p> <p>38 x 57 is approximately 40 x 60 = 2400.</p> <table style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">38</td> <td style="padding: 5px;">or</td> <td style="padding: 5px;">38</td> </tr> <tr> <td style="padding: 5px;"><u>x 57</u></td> <td></td> <td style="padding: 5px;"><u>x 57</u></td> </tr> <tr> <td style="padding: 5px;">266</td> <td></td> <td style="padding: 5px;">266</td> </tr> <tr> <td style="padding: 5px;">1900</td> <td></td> <td style="padding: 5px;">1900</td> </tr> <tr> <td style="padding: 5px;">2166</td> <td></td> <td style="padding: 5px;">2166</td> </tr> </table> <div style="border: 2px solid purple; border-radius: 15px; padding: 10px; width: fit-content; margin: 10px auto;"> <p><i>There is no ‘rule’ regarding the position of the ‘carry’ digits. Each choice has advantages and complications. Either carry the digits mentally or have your own favoured position for these digits.</i></p> </div>	38	or	38	<u>x 57</u>		<u>x 57</u>	266		266	1900		1900	2166		2166
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2166		2166																															

Stage 4: Long multiplication: HTU x TU

<p>Year 5/6</p>	<p>For HTU x TU, grid method is quite inefficient, and has much scope for error due to the number of ‘part-products’ that need to be added.</p> <p>Use this method when you find the standard method to be unreliable or difficult.</p> <p>423 x 68</p> <p>423 x 68 is approximately 400 x 70 = 28000.</p> <table style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <tr> <td style="border-right: 1px solid black; padding: 5px;">X</td> <td style="border-right: 1px solid black; padding: 5px;">60</td> <td style="border-right: 1px solid black; padding: 5px;">8</td> <td style="border: none;"></td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">400</td> <td style="border-right: 1px solid black; padding: 5px;">24000</td> <td style="border-right: 1px solid black; padding: 5px;">3200</td> <td style="padding: 5px;">27200</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">20</td> <td style="border-right: 1px solid black; padding: 5px;">1200</td> <td style="border-right: 1px solid black; padding: 5px;">160</td> <td style="padding: 5px;">1360</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">3</td> <td style="border-right: 1px solid black; padding: 5px;">180</td> <td style="border-right: 1px solid black; padding: 5px;">24</td> <td style="padding: 5px;">204</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;"></td> <td style="border-right: 1px solid black; padding: 5px;"></td> <td style="border-right: 1px solid black; padding: 5px;"></td> <td style="padding: 5px;">28764</td> </tr> </table>	X	60	8		400	24000	3200	27200	20	1200	160	1360	3	180	24	204				28764	<p>Many children choose the standard method. For HTU x TU calculations it is especially efficient, and less prone to errors when mastered. This can also be used for multiplying decimals.</p> <p>423 x 68</p> <p>423 x 68 is approximately 400 x 70 = 28000.</p> <table style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">423</td> <td style="padding: 5px;">or</td> <td style="padding: 5px;">423</td> </tr> <tr> <td style="padding: 5px;"><u>x 68</u></td> <td></td> <td style="padding: 5px;"><u>x 68</u></td> </tr> <tr> <td style="padding: 5px;">3384</td> <td></td> <td style="padding: 5px;">3384</td> </tr> <tr> <td style="padding: 5px;">25380</td> <td></td> <td style="padding: 5px;">25380</td> </tr> <tr> <td style="padding: 5px;">28764</td> <td></td> <td style="padding: 5px;">28764</td> </tr> </table> <div style="border: 2px solid purple; border-radius: 15px; padding: 10px; width: fit-content; margin: 10px auto;"> <p><i>As before, either carry the ‘carry’ digits mentally or decide on your own favoured position for them.</i></p> </div>	423	or	423	<u>x 68</u>		<u>x 68</u>	3384		3384	25380		25380	28764		28764
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Written methods for division of whole numbers

The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use an efficient written method accurately and with confidence.

These notes show the stages in building up to long division through Years 4 to 6 – first long division $TU \div U$, extending to $HTU \div U$, then $HTU \div TU$, and then short division $HTU \div U$.

To divide successfully in their heads, children need to be able to:

- understand and use the vocabulary of division – for example in $18 \div 3 = 6$, the 18 is the dividend, the 3 is the divisor and the 6 is the quotient;
- partition two-digit and three-digit numbers into multiples of 100, 10 and 1 in different ways;
- recall multiplication and division facts to 10×10 , recognise multiples of one-digit numbers and divide multiples of 10 or 100 by a single-digit number using their knowledge of division facts and place value;
- know how to find a remainder working mentally – for example, find the remainder when 48 is divided by 5;
- understand and use multiplication and division as inverse operations.

Children need to acquire **one efficient written method of calculation for subtraction** which they know they can rely on **when mental methods are not appropriate**.

Note: It is important that children’s mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for division.

To carry out expanded and standard written methods of division successfully, children also need to be able to:

- understand division as repeated subtraction or “grouping”;
- estimate how many times one number divides into another – for example, how many sixes there are in 47, or how many 23s there are in 92;
- multiply a two-digit number by a single-digit number mentally;
- understand and use the relationship between single digit multiplication, and multiplying by a multiple of 10. (e.g. $4 \times 7 = 28$ so $4 \times 70 = 280$ or $40 \times 7 = 280$ or $4 \times 700 = 2800$.)
- subtract numbers using the column method.

The above points are crucial. If children do not have a secure understanding of these prior learning objectives then they are unlikely to divide with confidence or success, especially when attempting the ‘chunking’ method of division.

For example, without a clear understanding that 72 can be partitioned into 60 and 12, 40 and 32 or 30 and 42 (as well as 70 and 2), it would be difficult to divide 72 by 6, 4 or 3 using the ‘chunking’ method.

$72 \div 6$ ‘chunks’ into 60 and 12

$72 \div 4$ ‘chunks’ into 40 and 32

$72 \div 3$ ‘chunks’ into 30 and 42 (or 30, 30 and 12)

Please note that there are two different ‘policies’ for chunking. We can teach chunking as a mental arithmetic / number line process, and prefer to count forwards in chunks rather than backwards.

Stage 1: Number line division and mental division (pre chunking)

Year group

Year 3

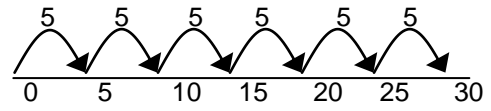
Start to emphasise grouping over sharing as a more efficient way to divide.

Beginning with the number line is an excellent way of linking division to multiplication. It can show division both as repeated subtraction, and as counting forward to find how many times one number 'goes into' another.

$$30 \div 5$$

or

-5 -5 -5 -5 -5 -5

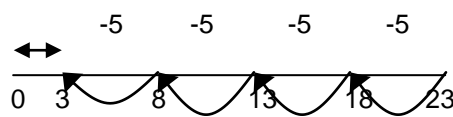


It also helps the children to deal with remainders.

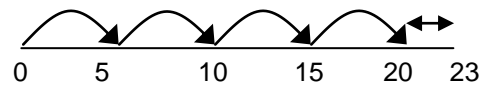
$$23 \div 5 = 4 \text{ r } 3$$

or

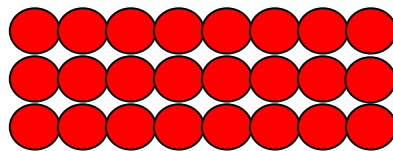
Harder



Easier!



Some children will continue to use arrays to develop their understanding of division, and to link to multiplication facts.

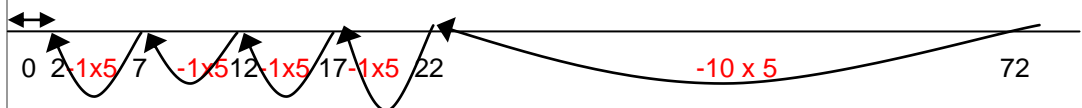


This array can show $24 \div 3$ and $24 \div 8$

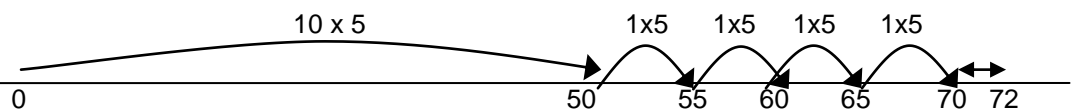
The number line is also an excellent way of introducing the 'chunking' approach.

$$72 \div 5 = 14 \text{ r } 2$$

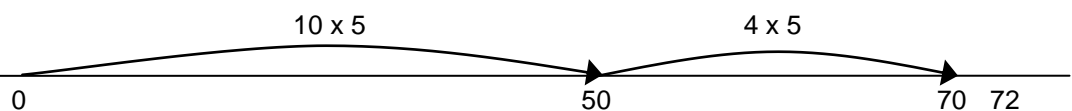
Harder



Or Easier!



Into a more efficient



Regularly stress the link between multiplication and division, and how children can use their tables facts to divide by counting forwards in steps.

Years 3 and 4

In lower KS2, children need a great deal of practice in mentally 'chunking' to develop their understanding of division. They can use an informal jotting to support their thinking.

These mental methods for dividing $TU \div U$ are usually based on partitioning in different ways.

$72 \div 5$	$72 \div 6$	$72 \div 4$	$72 \div 3$
$72 \div 5 = 14 \text{ r } 2$	$72 \div 6 = 12$	$72 \div 4 = 18$	$72 \div 3 = 24$
$\begin{array}{r} 50 \\ 22 \\ \hline 10 \times 5 \quad 4 \times 5 \text{ r } 2 \end{array}$	$\begin{array}{r} 60 \\ 12 \\ \hline 10 \times 6 \quad 2 \times 6 \end{array}$	$\begin{array}{r} 40 \\ 32 \\ \hline 10 \times 4 \quad 8 \times 4 \end{array}$	$\begin{array}{r} 60 \\ 12 \\ \hline 20 \times 3 \quad 4 \times 3 \end{array}$

Stage 2: Short division 'chunking'

Year group

Chunking – $TU \div U$

Year 4

- 'Short' division of $TU \div U$ introduces the 'chunking' method.
- This becomes more useful with $HTU \div U$ and later for long division.
- Chunking helps to consolidate the link between division and repeated subtraction.

Once children can understand chunking for $TU \div U$, they move on to $HTU \div U$ quite quickly.

When chunking we repeatedly subtract multiples or 'chunks' of the divisor.

$51 \div 3 = 17$

$$\begin{array}{r} 51 \\ - 30 \quad (10 \times 3) \\ \hline 21 \\ - 21 \quad (7 \times 3) \\ \hline 0 \end{array}$$

17

A 'chunk' of 10 lots of the divisor is the most common

Introduce chunking using simple examples that only require a single chunk of 10 lots of the divisor.

Progress to examples which may require more than one chunk of 10 lots of the divisor

$87 \div 3 = 29$

$$\begin{array}{r} 87 \\ - 30 \quad (10 \times 3) \\ \hline 57 \\ - 30 \quad (10 \times 3) \\ \hline 27 \\ - 15 \quad (5 \times 3) \\ \hline 12 \\ - 12 \quad (4 \times 3) \\ \hline 0 \end{array}$$

29

Begin by subtracting several chunks, but then try to find the biggest chunks of the divisor that can be subtracted.

OR

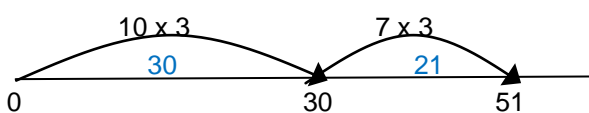
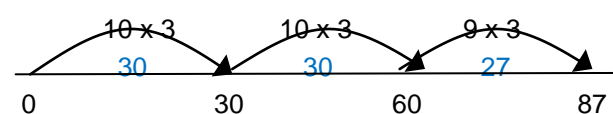

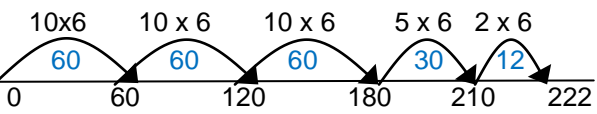
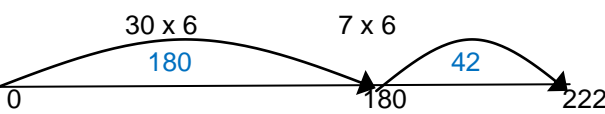
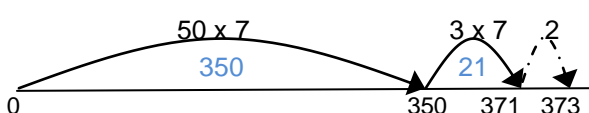
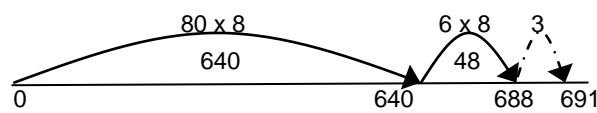
$$\begin{array}{r} 87 \\ - 60 \quad (20 \times 3) \\ \hline 27 \\ - 27 \quad (9 \times 3) \\ \hline 0 \end{array}$$

29

Chunking - HTU ÷ U

Year group	'Chunking' examples	Number line alternatives
Year 4	<p>Progress quickly to HTU ÷ U examples. Again, some children will initially subtract many chunks of the divisor.</p> <p>222 ÷ 6 = 37</p> $ \begin{array}{r} 222 \\ - \underline{60} \quad 10 \times 6 \\ 162 \\ - \underline{60} \quad 10 \times 6 \\ 102 \\ - \underline{60} \quad 10 \times 6 \\ 42 \\ - \underline{30} \quad 5 \times 6 \\ 12 \\ - \underline{6} \quad 1 \times 6 \\ 6 \\ - \underline{6} \quad 1 \times 6 \\ 0 \end{array} $ <p style="text-align: center;">37</p> <div style="border: 2px solid purple; border-radius: 15px; padding: 10px; text-align: center; margin: 10px 0;"> <p>These are inefficient. Try to find the largest possible chunks of the divisor to shorten the calculation.</p> </div> $ \begin{array}{r} 222 \\ - \underline{180} \quad 30 \times 6 \\ 42 \\ - \underline{6} \quad 1 \times 6 \\ 36 \\ - \underline{6} \quad 1 \times 6 \\ 30 \\ - \underline{6} \quad 1 \times 6 \\ 24 \\ - \underline{6} \quad 1 \times 6 \\ 18 \\ - \underline{6} \quad 1 \times 6 \\ 12 \\ - \underline{6} \quad 1 \times 6 \\ 6 \\ - \underline{6} \quad 1 \times 6 \\ 0 \end{array} $ <p style="text-align: center;">37</p> <p>If children have secure recall of x and ÷ facts, their chunking will soon become efficient.</p>	<p>Remember, the number line method can still be used for children who find the subtraction 'chunking' difficult. They are still finding chunks of the divisor but are counting on rather than counting back.</p> <p>222 ÷ 6 = 37</p> <p style="text-align: center;">222 ÷ 6 = 37</p>
<p>An estimate at the start will help children to find the largest chunks. If $6 \times 3 = 18$ and $6 \times 4 = 24$ then $6 \times 30 = 180$ and $6 \times 40 = 240$. Therefore the answer will be between 30 and 40</p>		
	<p>Make sure that you include examples that use remainders.</p> <p>373 ÷ 7 = 53 r 2</p> $ \begin{array}{r} 373 \\ - \underline{350} \quad 50 \times 7 \\ 23 \\ - \underline{21} \quad 3 \times 7 \\ 2 \\ \hline 53 \text{ r } 2 \end{array} $ <p style="text-align: center;">Answer = 53 r 2</p>	<p>373 ÷ 7 = 53 r 2</p>

Chunking – TU into HTU ÷ U – The alternative approach

Year group	‘Chunking’ examples – Find The Hunk	Number line alternatives
Year 4	<p>An alternative approach to the standard chunking method is to develop the mental strategy outlined earlier, and to use this as the main method in Years 4 & 5. This method could be called ‘Find The Hunk’.</p> <p>Using the same examples as before: -</p> <p>51 ÷ 3 = 17</p> <p style="margin-left: 40px;">30 (The ‘hunk’) 21</p> <p>÷ 3</p> <p style="margin-left: 40px;">10 7 = 17</p> <p>87 ÷ 3 = 29</p> <p style="margin-left: 40px;">30 30 27</p> <p>÷ 3</p> <p style="margin-left: 40px;">10 10 9 = 29</p> <p>Becomes</p> <p style="margin-left: 40px;">60 (The ‘mega hunk’) 27</p> <p>÷ 3</p> <p style="margin-left: 40px;">20 9 = 29</p> <p>222 ÷ 6 = 37</p> <p style="margin-left: 40px;">60 60 60 30 12</p> <p>÷ 6</p> <p style="margin-left: 40px;">10 10 10 5 2</p>	<p>Remember, the number line method can still be used for children who find it easier to support their thinking with a visual image. They are still completing the same mental process of finding chunks of the divisor.</p> <p>51 ÷ 3 = 17</p>  <p>87 ÷ 3 = 29</p>   <p>222 ÷ 6 = 37</p> 
	<p style="margin-left: 40px;">180 42</p> <p>÷ 6</p> <p style="margin-left: 40px;">30 7</p> <p>If children have secure recall of x and ÷ facts, their chunking will soon become efficient. Make sure that you include examples that use remainders.</p> <p>373 ÷ 7 = 53 r 2</p> <p style="margin-left: 40px;">350 23</p> <p>÷ 7</p> <p style="margin-left: 40px;">50 3 r 2</p> <p>691 ÷ 8 = 86 r 3</p> <p style="margin-left: 40px;">640 51</p> <p>÷ 8</p> <p style="margin-left: 40px;">80 6 r 3</p>	 <p>373 ÷ 7 = 53 r 2</p>  <p>691 ÷ 8 = 86 r 3</p> 

By this stage, children should always try to find the largest possible chunks of the divisor to shorten the calculation.

Stage 3: Short division – the compact method

Late Year 5
/ Year 6

Only use this 'standard' method when children have had lots of experience with the chunking method and are confident with all

The compact or 'bus shelter' method of short division is often introduced far too early (in Years 3 and 4). Although children who can recall their division facts are able to get the correct answer using this method, they have little understanding of why it works, and are not using the place value of each digit.

By leaving this method until Year 6, children can develop greater confidence in their actual understanding of division, and will hopefully be able to then apply the 'chunking' method to long division, as they will have had much more practice. This compact method can then be introduced to improve their speed in short division.

Initially, introduce this method by linking it to 'chunking'.

$$87 \div 3 = 29$$

$$\begin{array}{r} 20 + 9 \\ 3 \overline{)60 + 27} \end{array}$$

Then, refine the method into the traditional format, ensuring that all initial teaching is accompanied by a clear explanation of how this method works (see speech bubbles)

$$\begin{array}{r} 2 \\ 3 \overline{)87} \end{array}$$

*From 80, what is the largest number of 10s that will divide exactly by 3?
60 (or 6 tens) \div 3 = 20 (or 2 tens). Carry the remaining 20 to the units.*

$$\begin{array}{r} 29 \\ 3 \overline{)87} \end{array}$$

What is 27 divided by 3

When this method is secure for TU \div U then quickly progress to HTU \div U

Again, begin by briefly linking the method to 'chunking', using numbers where there is no carrying in the hundreds.

$$222 \div 6 = 37$$

$$\begin{array}{r} 30 + 7 \\ 6 \overline{)180 + 42} \end{array}$$

Refine the method, whilst clearly explaining the place value understanding.

$$\begin{array}{r} 3 \\ 6 \overline{)222} \end{array}$$

*From 220, what is the largest number of 10s that will divide exactly by 6?
220 \div 6 = 30 (or 3 tens). Carry the remaining 40 to the units.*

$$\begin{array}{r} 37 \\ 6 \overline{)222} \end{array}$$

What is 42 divided by 6?

An alternative is to say 'How many 6s in 220 – the answer must be a multiple of 10'

Finally, introduce examples of HTU ÷ U where there are also hundreds that need carrying, and where there are remainders.

$$583 \div 4 = 145 \text{ r } 3$$

$$\begin{array}{r} \underline{100 + 40 + 5} \quad \text{R } 3 \\ 4 \) \ 400 + 160 + 23 \end{array}$$

Continue to emphasise the place value until the children are secure with this method.

$$\begin{array}{r} 1 \\ 4 \) \ 5 \ 18 \ 3 \end{array}$$

From 500, what is the largest number of 100s that will divide exactly by 4?
 $400 \div 4 = 100$. Carry the remaining 100 to the ten.

Or, 'How many 4s in 500? The answer must be a multiple of 100.

$$\begin{array}{r} 1 \ 4 \\ 4 \) \ 5 \ 8 \ 3 \end{array}$$

From 180, what is the largest number of 10s that will divide exactly by 4?
 $180 \div 4 = 40$. Carry the remaining 20 to the units.

Or, 'How many 4s in 180? The answer must be a multiple of 10.

$$\begin{array}{r} 1 \ 4 \ 5 \ \text{R}3 \\ 4 \) \ 5 \ 8 \ 3 \end{array}$$

What is 23 divided by 4?

Stage 4: Long division - chunking

Year 6 (more able)

More able children can now tackle long division, beginning with HTU ÷ TU and then moving onto ThHTU ÷ TU. They will use the chunking method.

$$967 \div 26 = 37 \text{ R } 5$$

$$\begin{array}{r} 967 \\ - \underline{520} \quad 20 \times 26 \\ 447 \\ - \underline{260} \quad 10 \times 26 \\ 187 \\ - \underline{130} \quad 5 \times 26 \\ 57 \\ - \underline{52} \quad 2 \times 26 \\ 5 \end{array} = 37 \text{ R } 5$$

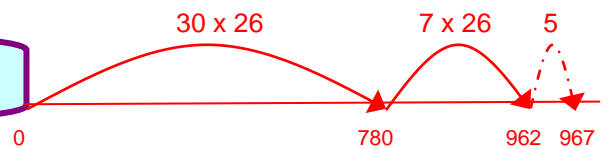
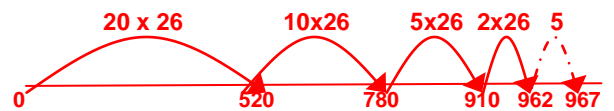
Try to find the largest chunks if possible.

$$\begin{array}{r} 967 \\ - \underline{780} \quad 30 \times 26 \\ 187 \\ - \underline{182} \quad 7 \times 26 \\ 5 \end{array} = 37 \text{ R } 5$$

This refined answer is actually the traditional long division method, but with place value kept secure, and with the advantage of being able to choose smaller chunks when necessary

As before, children can choose to use the number line method if they find forward chunking easier.

$$967 \div 26 = 37 \text{ R } 5$$



At this stage (Level 5) children can also create their own 'mental chunking' - see alternative 'Find The Hunk' method

780,	130	57 =
÷ 26	30	5
		2 r 5 = 37 R 5

Stage 5: Division of decimals

For some children, again at Level 5, the chunking method can be used for division of decimal numbers.

$158.4 \div 6 = 26.4$

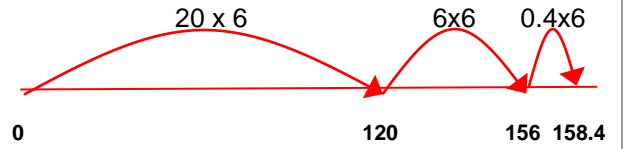
<u>158.4</u>	
- <u>120.0</u>	20×6
38.4	
- <u>36.0</u>	6×6
2.4	
- <u>2.4</u>	0.4×6
	= 26.4

Extend into division by decimals.

$22.4 \div 0.8 = 28$

<u>22.4</u>	
- <u>16.0</u>	20×0.8
6.4	
- <u>6.4</u>	8×0.8

$158.4 \div 6 = 26.4$



$22.4 \div 0.8 = 28$

