Calculation Policy for Mathematics

Gentleshaw Primary Academy

2020/21

About our Calculation Policy

The following calculation policy has been devised to meet requirements of the National Curriculum 2014 for the teaching and learning of mathematics, and is also designed to give pupils a consistent and smooth progression of learning in calculations across the school.

Age stage expectations

The calculation policy is organised according to age stage expectations as set out in the National Curriculum 2014, however it is vital that pupils are taught according to the stage that they are currently working at, being moved onto the next level as soon as they are ready, or working at a lower stage until they are secure enough to move on.

Providing a context for calculation:

It is important that any type of calculation is given a real life context or problem solving approach to help build children's understanding of the purpose of calculation, and to help them recognise when to use certain operations and methods when faced with problems. This must be a priority within calculation lessons.

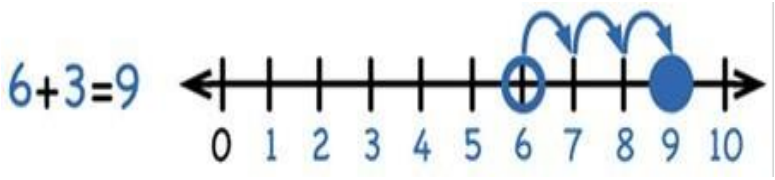
White Rose:

At Gentleshaw Academy planning follows the White Rose scheme of learning. Listed below are the formal methods that children will be taught at their respective age range. Children will also be taught using concrete and abstract methods. These methods can be found at http://mathshub.sjb.school/tag/white-rose/

Addition

Year 1 Add with numbers up to 20

Use numbered number lines to add, by counting on in ones. Encourage children to start with the larger number and count on.



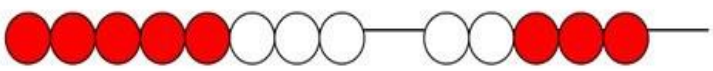
Children should:

- Have access to a wide range of counting equipment, everyday objects, number tracks and number lines, and be shown numbers in different contexts.
- Read and write the addition (+) and equals (=) signs within number sentences.
- Interpret addition number sentences and solve missing box problems, using concrete objects and number line addition to solve them: 8 + 3 = O

  15 + 4 = O 5 + 3 + 1 = O O + O = 6

This builds on from prior learning of adding by combining two sets of objects into one group (5 cubes and 3 cubes) in Early Years.

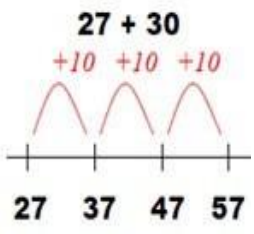
Bead strings or bead bars can be used to illustrate addition including bridging through ten by counting on 2 then counting on 3.



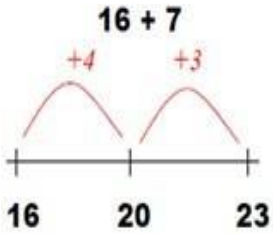
Addition

Year 2 Add with 2-digit numbers; developing mental fluency with addition and place value involving 2-digit numbers, then establish more formal methods.

Add 2-digit numbers and tens

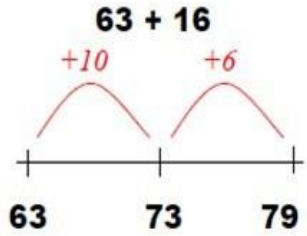


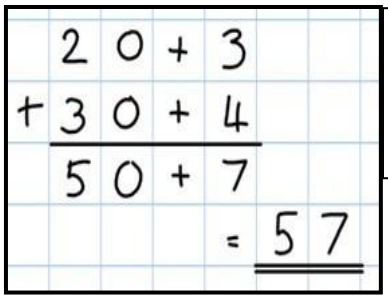
Add 2-digit numbers and units:



Use empty number lines, concrete equipment and 100 squares to build confidence and fluency in mental addition.

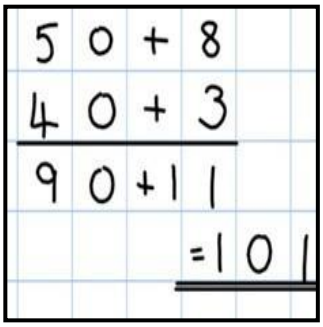
Add pairs of 2 digit numbers, moving to partitioned column method once secure adding tens and units. (Units first)





Note: Only use examples that do not cross the 10s boundary.

Note: Once children can add a multiple of 10 to a 2 digit number mentally (80+11), they are ready to add pairs of 2 digit numbers that do cross the 10s boundary.

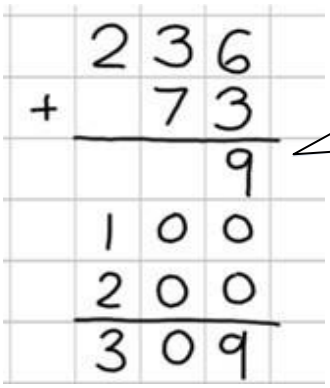


Note: Children who are confident and accurate should move to the expanded column method. (See year 3).

Addition

Year 3 Add numbers with up to 3-digits

Introduce the expanded column addition method:



Add the UNITS first, in preparation for the compact method.

In order to carry out this method of addition:

- Children need to recognise the value of the hundreds, tens and units without recording the partitioning.
- Pupils need to be able to add in columns.

Move to the compact column addition method, with carrying':

Add the units first.

'Carry' numbers underneath

236
+ 73
309
1

Children who are very secure with adding 3 digits using the expanded method should move to the column method where 'carrying' is introduced for the first time.

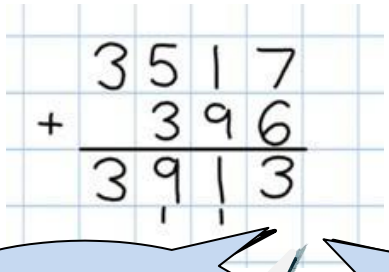
Children should understand the place value is 30 + 70 although we may say. 3 + 7

Addition

Year 4 Add numbers with up to 4 digits

Move from expanded addition to the compact column method, adding units first, and „carrying" numbers underneath the calculation. Also include money and measures contexts.

E.g. 3517 + 396 = 3913



Introduce the compact method by allowing the children to solve an addition using a method they are familiar with. Teacher then models 'carrying' underneath.

Add the units first.

Reinforce place value by modeling '500 + 300' and not 5 + 3.

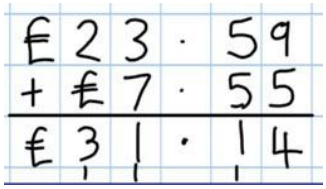
Carry' numbers underneath.

Use and apply this method in the contexts of money and measures

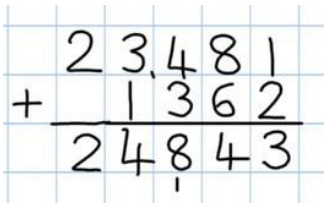
Addition

Year 5 Add numbers with more than 4 digits

Including money, measures and decimals with different numbers of decimal places.

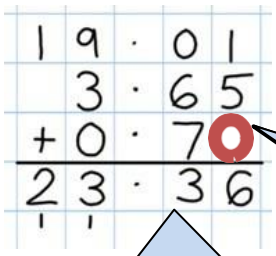


The decimal point should be aligned in the same way as the other place value columns, and must remain in the same column in the answer row.



Numbers should exceed 4 digits.

Pupils should be able to add more than two values, carefully aligning place value columns.



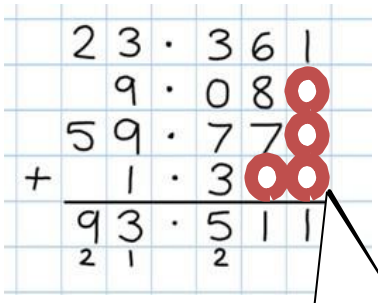
Empty decimal places can be filled with a 0 to show the place value in each column.

Say 6 tenths and 7 tenths to reinforce place value.

Children should:
Understand the place value of tenths and hundredths and use this to align numbers with different numbers of decimal places.

Addition

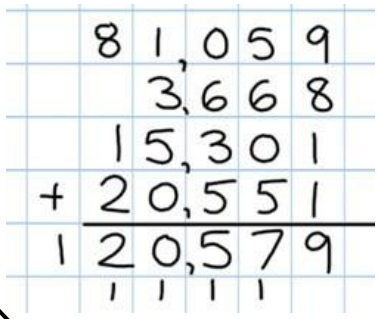
Year 6 Add several numbers of increasing complexity



'Empty decimal places can be filled with a 0 to show the place value in each column.

Adding several numbers with different numbers of decimal places (including money and measures):

- Tenths, hundredths and thousandths should be correctly aligned, with the decimal point lined up vertically including in the answer row.



Adding several numbers with more than 4 digits.

Subtraction

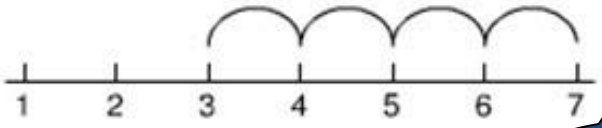
Year 1 Subtract from numbers up to 20

Children consolidate understanding of subtraction practically, showing subtraction on bead strings, using cubes etc. and in familiar contexts, and are introduced to more formal recording using number lines as below:

Read, write and interpret the – and = signs.

Subtraction by taking away:

Count backwards in 1s along a numbered number line, using numbers under 20.

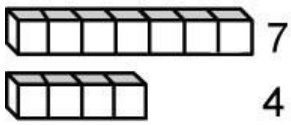


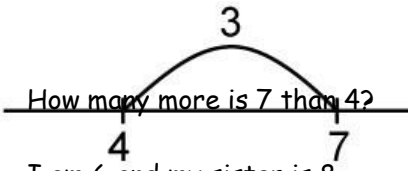
$7 - 4 = 3$

Model subtracting using 100 squares, numbered number lines/tracks and practically.

Finding the difference between:

Introduce this as 'finding the difference between' and 'how many more' in familiar contexts.





I am 6 and my sister is 8.
How much older is my sister?

The difference between 7 and 4 is 3.

Mental subtraction:

Children should start recalling subtraction facts up to and within 10 and 20, and should be able to subtract zero.

Subtraction

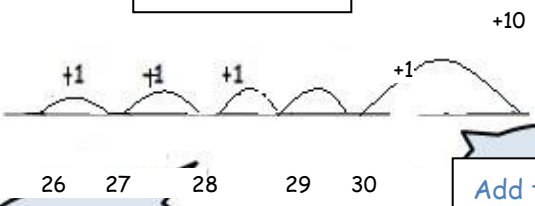
Year 2

Subtract 2 digits by counting on along a number line.

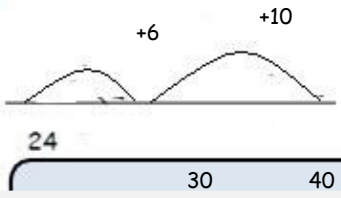
Children use their number bond to 10 knowledge to add the next number 'with a 0'.

40-26 =

Add to the jumps.



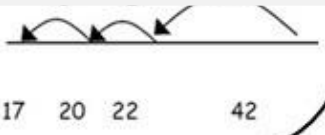
Add to the next



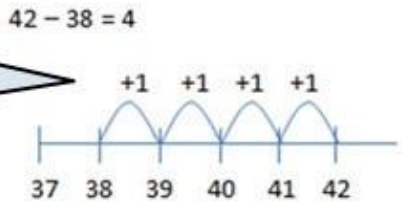
Add to the biggest

Children move to adding in less, more concise jumps.

Children should also be taught to count backwards along a number line.



Children solve mental subtractions by counting

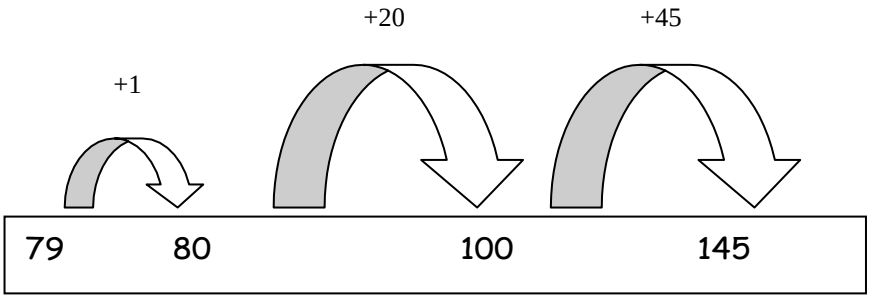


Subtraction

Year 3

Subtract 2 and 3 digits by counting on along a number line.

145 - 79 = 66



Children should be taught to add to the next 10 and then 100.

Once children are confident and accurate using a number line they should be taught to convert this into a formal written columnar method.

	1	4	5		
		7	9	=	
		1		(8	0)
	2	0		(10	0)
	4	5		(14	5)
	6	6			

Children write in brackets the number they have jumped to.

Children use this method to subtract 2 three digit numbers.

Subtraction

Year 4

Children should subtract at 4 digit numbers using columnar written method.

	2	5	3	7					
_	1	6	6	9					
				1	(1	6	7	0)	
			3	0	(1	7	0	0)	
		3	0	0	(2	0	0	0)	
		5	3	7	(2	5	3	7)	
		8	6	8					

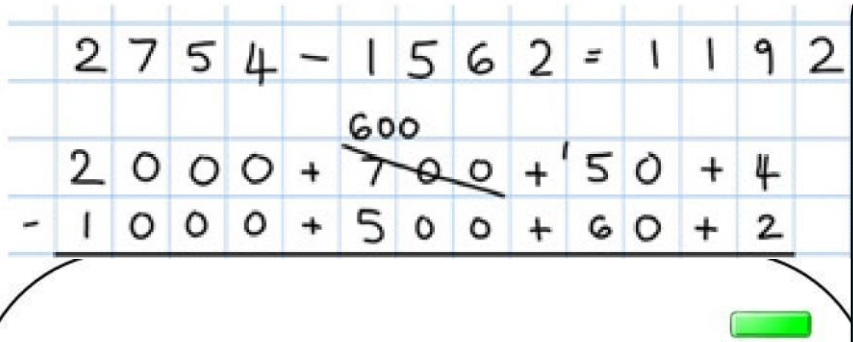
Children need to know number bonds to 10 and relate those facts to 100 and 1000.

Some children will be able to make less jumps, although this should be done at the expense of accuracy.

Subtraction

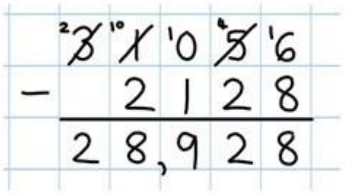
Year 5

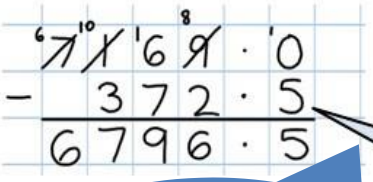
Towards the end of year 5, children should be taught to subtract numbers with more than 4 digits using compact column subtraction. (Decomposition)



Before moving to compact subtraction, children should be shown partitioned decomposition to ensure they understand the concept of 'borrowing'.

Children who are still not confident with place value will need to remain on the partitioned method





Add a zero to any empty spaces to aid understanding.

Create lots of opportunities for subtracting and finding the difference using money and measures.

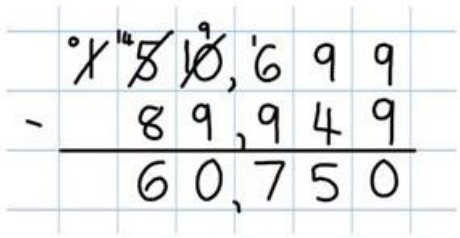
Subtract with decimal values, including mixtures of integers and decimals, aligning the decimal point.

Children should be able to mentally subtract larger numbers.

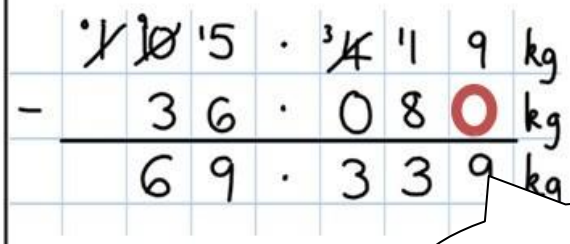
Subtraction

Year 6

Subtract increasingly large and more complex numbers and decimal values.



Using the compact column method to subtract more complex integers



Using the compact column method to subtract money and measure, including numbers with different numbers of decimal places.

Empty decimal places can be filled with a 0 to show place value in the column.

Approximate, calculate, check it mate!

Pupils should be able to apply their knowledge of a range of mental strategies, mental recall skills and informal and formal written methods when selecting the most appropriate method to work out subtraction problems.

Multiplication

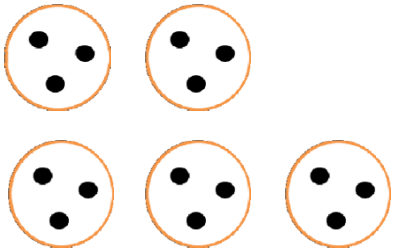
Year 1

Multiply with concrete objects, arrays and pictorial representations.

How many legs do 3 bears have?

2 + 2 + 2 = 6

There are 3 sweets in a bag. How many in 5 bags?



3 + 3 + 3 + 3 + 3 = 15

- Give children the experience of counting equal groups of objects in 2s, 5s and 10s
- Present practical problem solving activities involving counting equal sets or groups.

Children should also understand the symbol of multiplication and could begin to use it when recording their work.

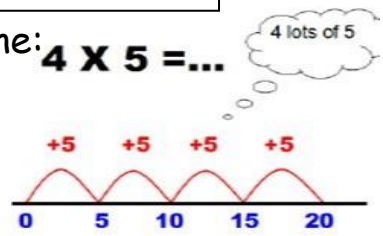
Multiplication

Year 2:

Multiplying using arrays and repeated addition (using at least 2s, 5s and 10s).

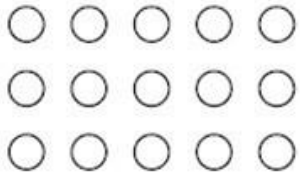
Use repeated addition on a number line:

- Starting from zero, make equal jumps up on a number line to work out multiplication facts and write multiplication statements using x and = signs.



4 X 5 = 20

Use arrays:



5 x 3 = 15

3 x 5 = 15

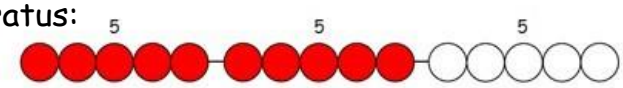
5 x 3 = 3 + 3 + 3 + 3 = 15

3 x 5 = 5 + 5 + 5 = 15

Use arrays to help teach children to understand the commutative law of multiplication, and give examples such as 3 x___= 15

5 x 3 = 5 + 5 + 5

Use practical apparatus:



Use mental recall:

- Children should begin to recall multiplication facts for 2, 5 and 10 times tables through practice in counting and understanding of the operation.

Multiplication

Year 3 Multiply 2-digits by a single digit number

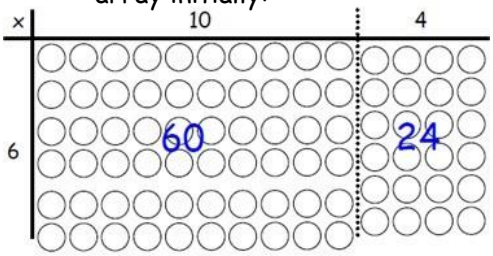
Introduce the grid method for multiplying 2-digit by single-digits:

Eg. 23 x 8 = 184

X	20	3
8	160	24

160 + 24 = 184

Link the layout of the grid to an array initially:



Introduce the grid method with children physically making an array to represent the calculation (e.g. make 8 lots of 23 with 10s and 1s place value counters), then translate this to grid method format (see video clip).

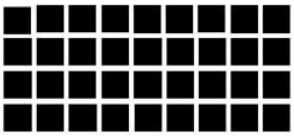
To do this, children must be able to:

1) Partition numbers into tens and units

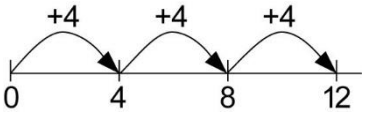
2) Multiply multiples of ten by a single digit (e.g. 20 x 4) using their knowledge of multiplication facts and place value

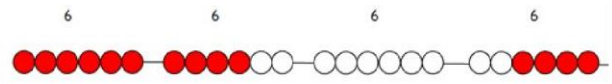
3) Recall and work out multiplication facts in the 2, 3, 4, 5, 8 and 10 times tables.

4) Work out multiplication facts not known by repeated addition or other taught mental strategies (e.g. by commutative law, working out near multiples and adjusting, using doubling etc.) Strategies to support this are repeated addition using a number line, bead bars and arrays:



9 x 4 = 36





Opportunities should be made to solve simple problems in different contexts.

Children should be able to use the commutative law to mentally solve questions such as;
4 x 12 x 5 = 4 x 5 = 20 x 12 = 240

Multiplication

Year 4

Multiply two and three digit numbers by a single digit, using all 12 x 12 multiplication facts.

Developing the grid method.

Eg. 136 x 5 = 680

X	100	30	6
5	500	150	30

500
150
+30
680

Encourage children to use column addition to add accurately.

Move on to short multiplication (year 5) if and when children are confident and accurate in multiplying 2 and 3 digit numbers by a single digit this way AND are already confident in 'carrying' for written addition.

Children should be able to:

Approximate before they calculate, and make this a regular part of their calculating, going back to the approximation to check the reasonableness of their answer.

e.g.: 349 x 9 is approximately 350 x 10 = 3500

Multiply multiples of 10 by 10 using their times tables knowledge.

Recall all 12 x 12 facts.

Approximate
Calculate
Check it mate!

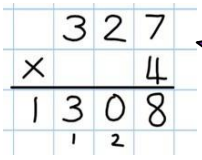
Multiplication

Year 5 Multiply up to 4-digits by 1 or 2 digits.

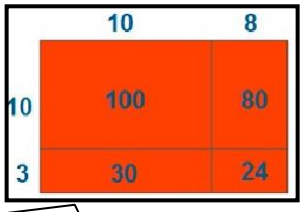
Introducing column multiplication;

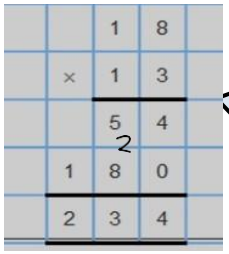
Introduce by comparing a grid method calculation to a short multiplication method, to see how the steps are related, but notice how there are less steps involved in the column method (see video).
Children need to be taught to approximate first, e.g. for 72 x 38, they will use rounding: 72 x 38 is approximately 70 x 40 = 2800, and use the approximation to check the reasonableness of their answer against.

x	300	20	7
4	1200	80	28



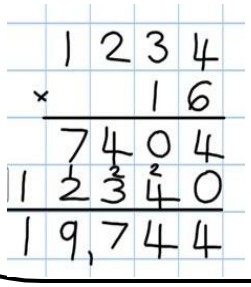
Children could be asked to solve a problem using both the grid and compact method and discuss similarities and differences.

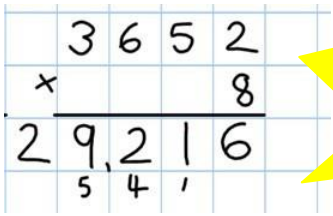




18 x 3 on the first row (8 x 3 is 24, carry the 2 and then 1 x 3)
18 x 10 on the second row. (Put the 0 in the units first and then 1 x 8 and 1 x 1.)

Grid could be used to introduce long multiplication as the relationship between numbers can be seen.



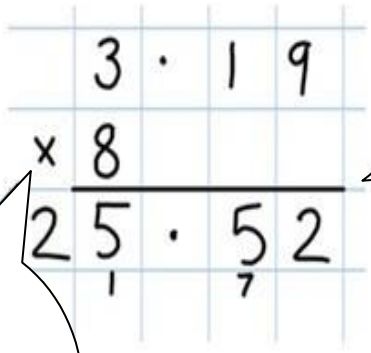


Approximate
Calculate
Check it mate!

Multiplication

Year 6

Short and long multiplication as in year 5 and multiply decimals, with up to two d.p, by a single digit.



Line up the decimal points in the question and answer.

Remind children that the single digit belongs in the units column.

This works well for multiplying money (£ p.) and other measures.

Children will be able to:

1) Use rounding and place value to make approximations before calculating and use these to check answers against.
2) Use short multiplication (see Y5) to multiply numbers with more than 4-digits by a single digit; to multiply money and measures, and to multiply decimals with up to 2d.p. by a single digit.
3) Use long multiplication (see Y5) to multiply numbers with at least 4 digits by a 2-digit number.

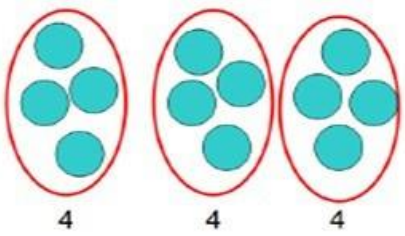
Approximate
Calculate
Check it mate!

Division

Year 1 Group and share small quantities

Using objects, diagrams and pictorial representations to solve problems involving both grouping and sharing.

How many groups of 4 can be made with 12 stars? = 3



12 shared between 3 is 4

Start children off in a familiar context;
There are 18 pieces of fruit on the table. There are 6 children. How many pieces of fruit will each child get?

Can they use a division statement?
18 shared by 6 people = 3 each

Children should:

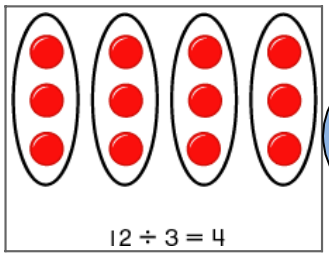
- Use lots of apparatus, arrays and picture representations
- Be taught the difference between grouping and sharing
- Be able to count in multiples of 2, 5 and 10
- Understand and find half of a group of objects by sharing into two equal groups

Division

Year 2 Group and share, using the ÷ and = sign

Use objects, arrays, diagrams and pictorial representations, and grouping on a number line.

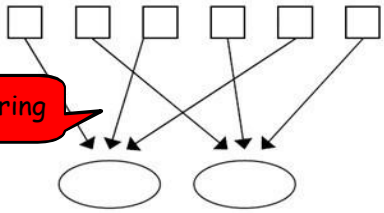
Arrays:



This represents 12 ÷ 3 =
How many groups of 3 in 12?
Children should understand that this array also shows 12 ÷ 4 if group horizontally.

6 sweets shared between 2 people, how many do they each get?

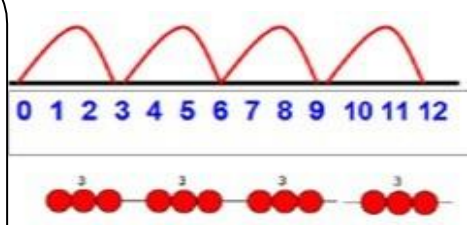
Sharing



Grouping

There are 6 sweets, how many people can have 2 sweets each?

Grouping use a number line:
Group from zero in equal jumps of the divisor to find out 'how many _ in _?'.
Beads strings or practical apparatus could be used to solve problems like; A C.D. costs £3, how many C.Ds can I buy with £12?



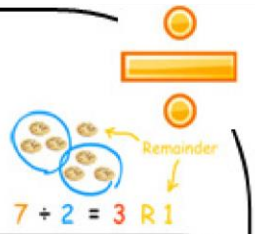
12 ÷ 3 = 4

Pose 12 ÷ 3 as how many groups of 3 in 12?

Division

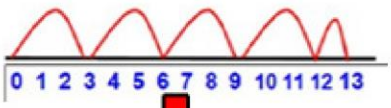
Year 3 Divide 2-digit numbers by a single digit (where there is no remainder in the final answer)

Children continue to solve unknown divisions by grouping along a number line from 0.



Grouping on a number line

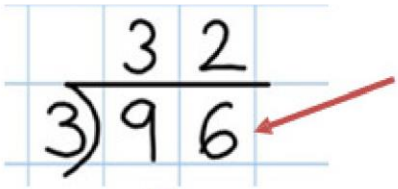
13 ÷ 3 =



They are also now taught the concept of remainders, as in the example. This should be introduced practically and with arrays, as well as being translated to a number line. Children should work towards calculating some basic division facts with remainders mentally for the 2s, 3s, 4s, 5s, 8s and 10s ready for 'carrying' remainders across within short division.

Short division: limit numbers to NO remainders in the answer or carried (each digit must be a multiple of the divisor).

Once the children are confidently using number lines arrays etc., short division for larger numbers should be introduced.

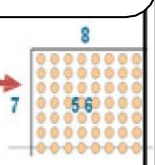


Remind children of the place value of

numbers. 96 = 90 + 6.

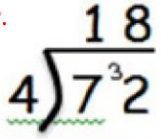
Start by comparing the layout of short division

by comparing it to an array.



Real life contexts need to be used routinely to help children gain a full understanding, and the ability to recognise the place of division and how to apply it to problems.

Limit numbers to no remainders in the final answer.



Once children show full understanding of remainders AND the method of short division, they can be taught how to use the method when remainders occur within the calculation (e.g. 96 ÷ 4) and be taught to 'carry' the remainder onto the next digit. If needed, children should a number line to work out individual division facts that occur which they are not yet able to mentally recall.

This final step is only taught once the children are confident with 'remainders'.

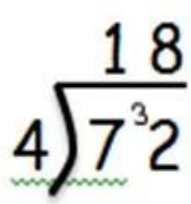
Division

Year 4

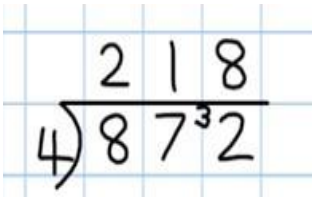
Divide up to 3 digit numbers by a single digit (without reminders initially).

Continue to develop short division.

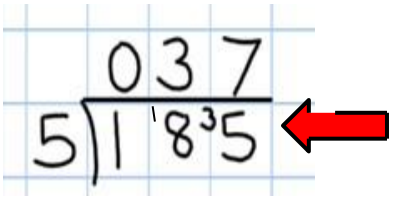
Short division should only be taught once children have secured the skill of calculating remainders.



Pupils must be secure with the process of short division for dividing 2 digit numbers by a single digit (those that do not result in a final remainder) but they must understand how to calculate reminders, using this to 'carry' remainders within the calculation.



Pupils move onto dividing numbers with up to 3 digits by a single digit, however problems and calculations provided should not result in a final answer with remainder at this stage.



When the answer for the first column is zero, the children may write a 0 to acknowledge its place, and must always 'carry' the number (1) over the next digit as a remainder.

Include money and measure contexts when confident.

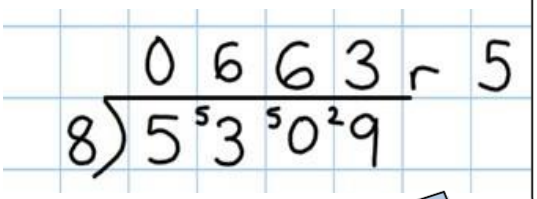
Real life contexts need to be used routinely to help children gain a full understanding, and the ability to recognise the place of division and how to apply it to problems.

Division

Year 5

Divide up to 4 digit numbers by a single digit, including those with remainders.

Short division, including remainder answers:



Now that pupils are introduced to examples that give rise to remainder answers, division needs to have a real life problem solving context, where pupils consider the meaning of remainder and how to express it. i.e. as a fraction, decimal, or as a rounded number or value.

This answer could be expressed as 663 and five eighths, 663 r 5 as a decimal or rounded as appropriate to the context.

See year 6 for how to continue short division to give a decimal answer.

Include money and measure contexts.

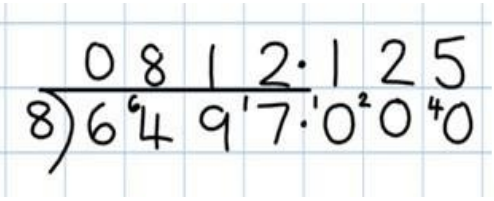
If children are confident and accurate:
Introduce chunking for long division for pupils who are ready to divide any number by a 2 digit number. (2678 ÷19). This is a year 6 expectation – see year 6.

Division

Year 6

Divide up to 4 digit numbers by both single digit and 2 digit numbers.

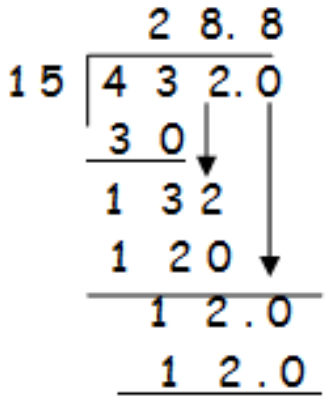
Short division



Short division with remainders: Pupils should continue to use this method, but with numbers to at least 4 digits, and understand how to express remainders as fractions, decimals, whole number remainders and rounded numbers. Real life problem solving contexts need to be the starting point where pupils have to consider the most appropriate way to express the number.

Calculating a decimal remainder: In this example, rather than expressing the remainder as r1, a decimal point is added after the units because there is still a reminder and the one remainder is carried onto zeros after the decimal point (to show there was no decimal value in the original number). Keep dividing to an appropriate degree of accuracy for the problem being solved.

Long division – Bus Stop.



- Children will refer to the WIK box to check how many 15s can be subtracted away from the number.

Must be aligned in the correct place value for subtracting

Children will need to create a 'WIK' box (what I know) at the side of their book.

e.g. 15
30
45
60
75

Approximate
Calculate
Check