ALEC REED ACADEMY

Calculations policy 2021-2022

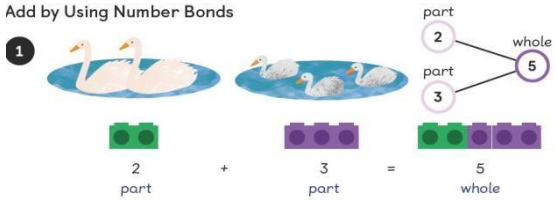
Note: carrying over will be at the bottom of the calculation for addition and multiplication (when multiplying one digit with 2 or 3 digits), however when multiplying 2 digit with 2 or 3 digits you will carry over at the top.

Year 1 Addition

Counting and Combining sets of Objects to 20

Combining two sets of objects e.g. Numicon, bundles of straws, Dienes apparatus, multi-link cubes, bead strings, ten frames, etc. which will progress onto adding on to a set.

Understanding of counting using knowledge of number bonds



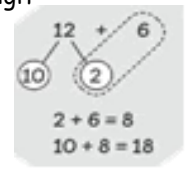
Understanding of counting on (supported by models and images).

7+ 4

If appropriate, progress from using number lines with every number shown to number lines with significant numbers shown.

Partitioning to add

Children should be able to separate 2 digit numbers to add the ones then add the tens.



+ = signs and missing numbers

Children need to understand the concept of equality before using the '=' sign. Calculations should be written either side of the equality sign so that the sign is not just interpreted as 'the answer'.

2 = 1+ 1

2 + 3 = 4 + 1

Year 2 Addition

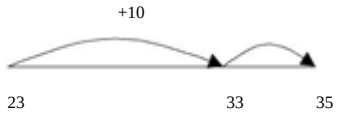
It is valuable to use a range of representations (also see Y1). Continue to use objects , number lines and ten frames to develop understanding of commutative law and of:

Counting on in tens and ones

23 + 12 = 23 + 10 + 2

= 33 + 2

= 35

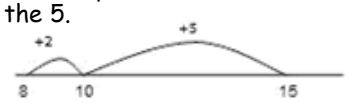


Partitioning and bridging through 10.

The steps in addition often bridge through a multiple of 10

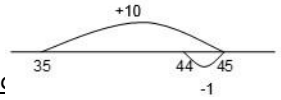
e.g. Children should be able to partition the 7 to relate adding the 2 and then the 5.

8 + 7 = 15



Adding 9 or 11 by adding 10 and adjusting by 1

e.g. Add 9 by adding 10 and adjusting by 1



Towards a Written Method

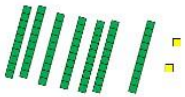
Partitioning in different ways and

47+25

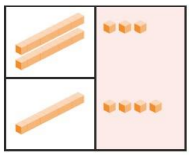
47 **25** **60 + 12**

Leading to exchanging:

72



Standard column method:



	tens	ones
	2	3
+	1	4
		7

Missing number problems e.g. 14 + 5 = 10 + □ 32 + □ + □ = 100 35 = 1 + □ + 5

Year 3 Addition

Partition into tens and ones

Partition both numbers and recombine.

Count on by partitioning the second number only

e.g.

247 + 125 = 247 + 100 + 20+ 5

= 347 + 20 + 5

= 367 + 5

= 372

Children need to be secure adding multiples of 100 and 10 to any three-digit number including those that are not multiples of 10.

Towards a Written Method to 1000

Standard column addition can be modelled with place value counters, objects and pictorial representations.

	h	t	o
			8
+	2	3	6
		1	4
		3	0
+	2	0	0
	2	4	4

Leading to children understanding the renaming between tens and ones (carrying/exchanging).

T U	H T U
56	56
+ 67	+ 67
3	123
1	1

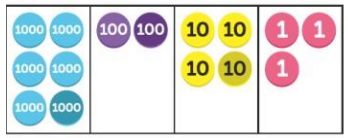
Introduce the Bar Method

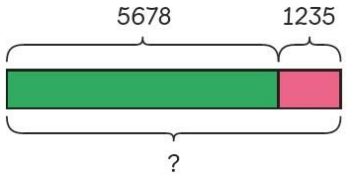
Missing number problems using a range of equations as in Year 1 and 2 but with appropriate, larger numbers.

Year 4 Addition

Mental methods (within 10,000) should continue to develop, supported by a range of models and images, including the number line.

Written methods (progressing to 4-digits & 1dp)
Continue to model column addition modelled with place value counters, objects, pictorial representations and the Bar Method.





	4	2	5	6
+	1	9	8	7
			1	3
		1	3	0
	1	1	0	0
+	5	0	0	0
	6	2	4	3

add ones
add tens
add hundreds
add thousands

Extend to numbers with at least four digits, including renaming between various columns (carrying).

789 + 642 becomes

	h	t	o
	7	8	9
+	6	4	2
	1	4	3	1
		1	1	

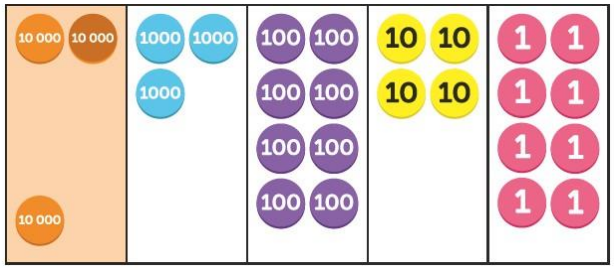
Answer: 1431

Select and use different methods to solve word problems, involving two step problems in context.

Year 5 Addition

Mental methods (within 1,000,000) should continue to develop, supported by a range of models and images, including place value counters. Children should practise with increasingly large numbers to aid fluency
e.g. 12462 + 2300 = 14762

Written methods (progressing to more than 4-digits & 2dp)
As in Year 4, continue to explore column addition modelled with place value counters, objects, pictorial representations and the Bar Method



Children will move on to the formal columnar method for whole numbers and decimal numbers as an efficient written method.

789 + 642 becomes

	7	8	9
+	6	4	2
1	4	3	1
	1	1	

Select and use different methods to solve word problems, involving two step problems in context.

Year 6 Addition

Mental methods should continue to develop, supported by a range of models and images, including the number line.

Written methods
As in Year 5, progressing to larger numbers, aiming for both conceptual understanding and procedural fluency with columnar method to be secured. Continue to model with place value counters, objects, pictorial representations and the Bar Method.

Continue calculating with decimals, including those with different numbers of decimal places, and develop procedural fluency with renaming (carrying) to be secured.

	4	2	.	7
+	8	9	.	5
1	3	2	.	2
	1	1		

Problem Solving
Teachers should ensure that pupils have the opportunity to apply their knowledge in a variety of contexts and problems (exploring cross curricular links) to deepen their understanding.

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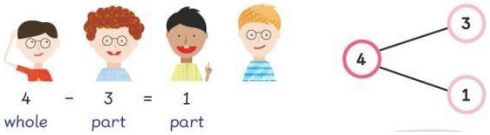
Year 1 Subtraction

Understand subtraction as crossing out (take-away) (within 20):

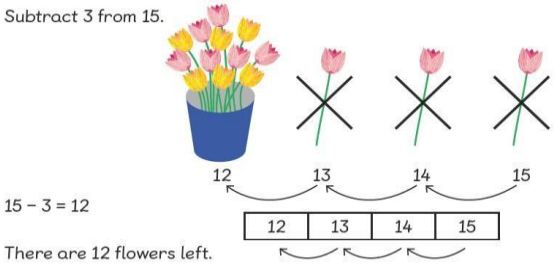
7 – 2 = 5

Using knowledge of number bonds to subtract (within 20):



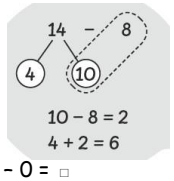
Understand subtraction as counting back (within 20):

Use concrete objects and pictorial representations. Progress from using number lines with every number shown to number lines with significant numbers shown.



Partitioning to subtract

Children should be able to separate 2 digit numbers to subtract from the tens then add the leftover ones

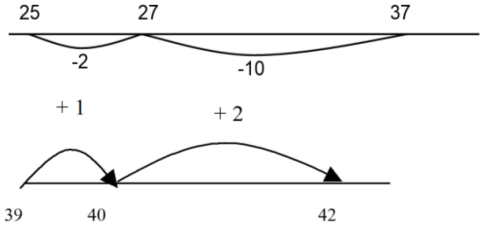


Missing number problems e.g.

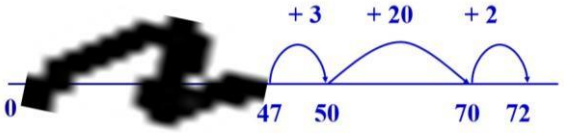
7 = □ - 9; 20 -□ = 9; 15 – 9 = □; □ - □ = 11; 16 – 0 = □

Year 2 Subtraction

It is valuable to use a range of representations (also see Y1). Continue to use dienes, number lines, ten frames and objects to model take-away and difference. E.g.



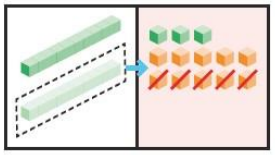
The link between the two may be supported by an image like this, with 47 being taken away from 72, leaving the difference, which is 25.



Towards written methods within 100

Record addition and subtraction in columns, the numbers may be represented with objects and pictorial representations. E.g. 23 – 5. Progress to renaming (borrowing).

Regroup 1 ten into 10 ones.
Subtract the ones.
13 ones – 5 ones = 8 ones



	tens	ones
	1 ~~2~~	13 ~~3~~
–		5
		8

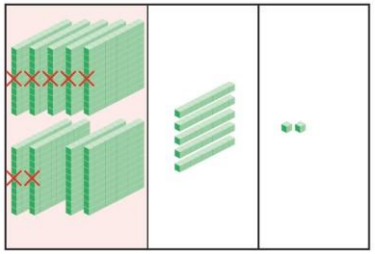
Missing number problems, including use of inverse relationships e.g. 52 – 8 = □; □ – 20 = 25; 22 = □ – 21; 6 + □ +3=11

Year 3 Subtraction

Mental methods should continue to develop, supported by a range of models and images, including the number line. Children should make choices about which strategy to use, depending on the numbers involved.

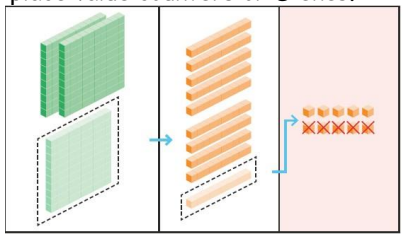
Written methods (progressing to 3-digits)

Continue to model column subtraction with no renaming (borrowing/decomposition), modelled with objects such as place value counters, Numicon and Dienes.



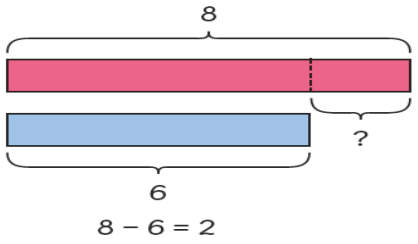
	h	t	o
	9	7	5
–	7	2	3
	2	5	2

This will lead to renaming (borrowing), modelled using place value counters or Dienes.



	h	t	o
	~~2~~ 1	~~10~~ 9	~~10~~ 0
–	1	2	5
			5

Introduce the Bar Method



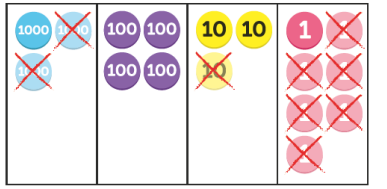
8 – 6 = 2

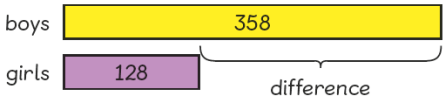
Missing number problems, including use of inverse relationships e.g. □ = 43 – 27; 145 – □ =138; 274 – 30 = □; 245 – □ = 195; 532 – 200 = □; 364 – 153 = □

Year 4 Subtraction

Mental methods (within 10,000) should continue to develop, supported by a range of models and images, including partitioning.

Written methods (progressing to 4-digits & 1 dp)
Continue to use column subtraction modelled with place value counters, objects, pictorial representations and the Bar Method

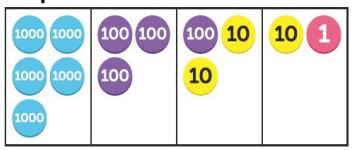




Extend to numbers with at least four digits, including renamina between various columns (borrowing).

$$\begin{array}{r} \cancel{5}\ \ \cancel{2}\ \ \cancel{8}^{7}\ \ \cancel{0}^{10} \\ -\ 3\ \ 1\ \ 6\ \ 9 \\ \hline 2\ \ 1\ \ 1\ \ 1 \end{array}$$

Use place value counters to explore compensation method:



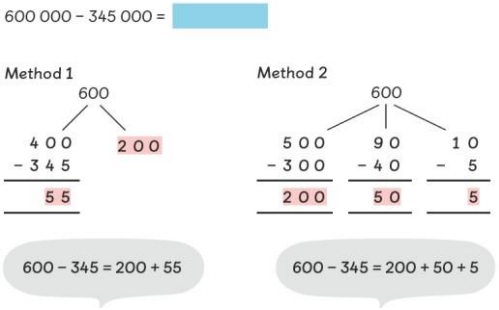
$$\begin{array}{r} 5\ \ 3\ \ \cancel{2}^{12}\ \ \cancel{1}^{11} \\ -\ 1\ \ \cancel{2}\ \ \cancel{4}\ \ 8 \\ \hline \end{array}$$

Select and use different methods to solve word problems, involving two step problems in context.

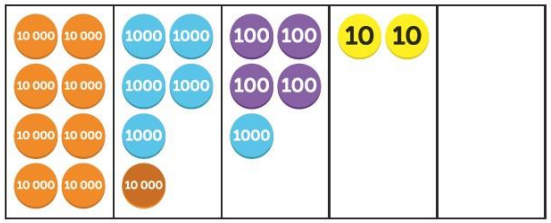
Missing number/digit problems, including use of inverse relationships: 200 – 90 – 80 = □; 225 - □ = 150
□ – 25 = 67; □ - 2000 = 900

Year 5 Subtraction

Mental methods (within 1 000 000) should continue to develop, supported by a range of models and images, including partitioning.



Written methods (progressing to more than 4-digits)
As in Year 4, continue to use place value counters to support understanding of decomposition (renaming/borrowing) in formal written method.
E.g. 96 420 – 87 531 =



$$\begin{array}{r} \overset{15}{\cancel{8}\ \cancel{16}}\ \ \overset{14}{\cancel{9}\ \cancel{6}}\ \ \cancel{4}\ 2\ 0 \\ -\ \ 8\ 7\ \ 5\ 3\ 1 \\ \hline \\ \hline \end{array}$$

Continue to select and use different methods to solve word problems, involving two step problems in context.

Missing number/digit problems: 6.45 = 6 + 0.4 + □;
119 - □ = 86; 1 000 000 - □ = 999 000;
600 000 + □ + 1000 = 671 000; 12 462 – 2 300 = □

Year 6 Subtraction

Mental methods should continue to develop, supported by a range of models and images,

Written methods
As in Year 5, progressing to larger numbers, aiming for both conceptual understanding and procedural fluency with columnar method to be secured. Continue to model with place value counters, objects, pictorial representations and the Bar Method

Continue calculating with decimals, including those with different numbers of decimal places, and develop procedural fluency with decomposition (borrowing) to be secured.

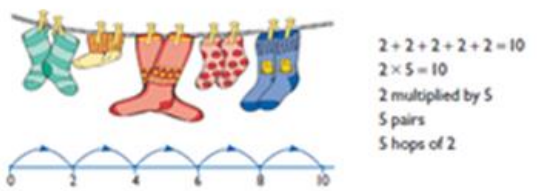
$$\begin{array}{r} \pounds\ \overset{14}{\cancel{1}}\ \cancel{5}\ .\ \overset{9}{\cancel{0}}\ \overset{10}{\cancel{0}} \\ -\ \pounds\ 1\ 3\ .\ 4\ 5 \\ \hline \pounds\ \square\ .\ \square\ \square \\ \hline \end{array}$$

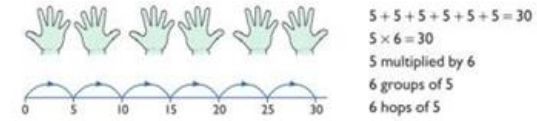
Problem Solving
Teachers should ensure that pupils have the opportunity to apply their knowledge in a variety of contexts and problems (exploring cross curricular links) to deepen their understanding.

Year 1 Multiplication

Understand multiplication is related to doubling and combing groups of the same size (repeated addition) for 2, 5, 10.

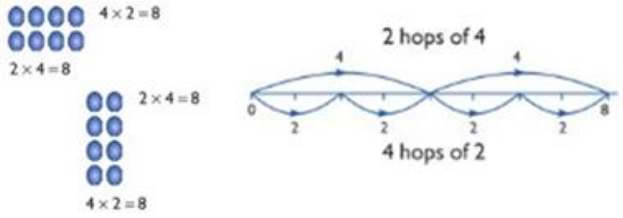
Washing line, and other practical resources for counting. Concrete objects: Dienes, Numicon, bundles of straws, bead strings.





Problem solving with concrete objects (including money and measures)

Use arrays to begin to understand multiplication can be done in any order (commutative)



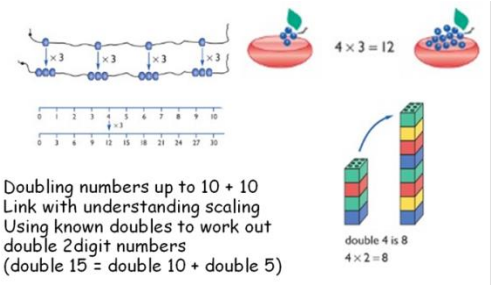
Year 2 Multiplication

Expressing multiplication as a number sentence using x and explore commutative law of multiplication

Recall and use multiplication facts for the 2, 5 and 10 multiplication tables

Develop understanding of solving multiplication problems using arrays, objects, pictorial representations and number lines (see Year 1).

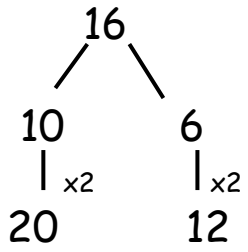
Begin to develop understanding of multiplication as scaling (3 times bigger/taller)



Doubling numbers up to 10 + 10
Link with understanding scaling
Using known doubles to work out
double 2digit numbers
(double 15 = double 10 + double 5)

Towards written methods

Use arrays and jottings to develop an understanding of doubling two digit numbers.



Use understanding of the inverse and practical resources to solve missing number problems.

7 x 2 = □ □ = 2 x 7

7 x □ = 14 14 = □ x 7

□ x 2 = 14 14 = 2 x □

Year 3 Multiplication

Mental methods

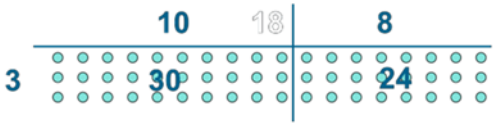
Doubling 2 digit numbers using partitioning

Demonstrating multiplication on a number line – jumping in larger groups of amounts
13 x 4 = 10 groups of 4 then 3 groups of 4

Recall and use multiplication facts for the 3, 4 and 8 multiplication tables

Written methods (progressing to 3digit x 1digit)

Developing written methods using understanding of visual images to group and create equal groups of objects and pictures



Give children opportunities for children to explore this and deepen understanding of commutative law of multiplication using Numicon, Dienes , place value counters and pictorial representations.

Develop understanding of solving multiplication problems using arrays, objects, pictorial representations and number lines (see Year 1).

Year 4 Multiplication

Mental methods
Counting in multiples of 6, 7, 9, 25 and 1000, and steps of 1/100.

Recall and use multiplication facts for the 6, 7, 9, 11 and 12 multiplication tables

Use known facts to multiply by multiples of 10

Written methods (progressing to 3digit x 2digit, including 1dp)
Children to embed and deepen their understanding to multiply up to 2d x 2d progressing to 3d x 2d and decimals to 1dp. Ensure this is still linked back to their understanding of arrays and supported using place value counters.

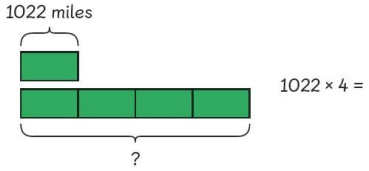
		2	3
×			6
		1	8
+	1	2	0
	1	3	8

Leading to short written method including renaming (carrying):

24 × 6 becomes

		2	4
×			6
1	4	4	
		2	

Children to use their knowledge of multiplication tables and inverse, supported by pictorial representations and the Bar method to help solve word problems in context.



1022 × 4 =

Year 5 Multiplication

Mental methods
X whole numbers and decimals by 10, 100, 1000 using knowledge of place value to move digits

Use practical resources and jottings to explore equivalent statements (e.g. 4 x 35 = 2 x 2 x 35)

Recall of prime numbers up to 19 and identify prime numbers up to 100 (with reasoning)

Identify multiples and factor pairs for numbers

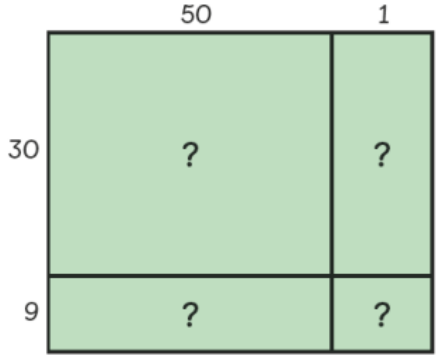
Written methods (progressing to 4d x 2d)
Children to continue to explore long and short methods:

	1	1	8
×			3
2	4	→ multiply by ones	
3	0	→ multiply by tens	
+ 3	0	0 → multiply by hundreds	
3	5	4	

	2	7	4	1
×				6
1	6	4	4	6
	4	2		

As in Year 4, children to use their knowledge of multiplication tables and inverse, supported by pictorial representations and the Bar Method, to help solve word problems in context.

Introduce grid method to multiply 2 digit numbers by 2 digit numbers e.g. 39 x 51 =



Year 6 Multiplication

Mental methods
Identifying common factors and multiples of given numbers and prime numbers
X 2d and 3d numbers by 1d mentally or using jottings
Perform mental calculations including mixed operations and large numbers

Written methods
Continue to refine and deepen understanding of written methods including grid method, expanded column and fluency for using column multiplication supported by jottings and the Bar Method
Grid method:

X	1000	300	40	2
10	10000	3000	400	20
8	8000	2400	320	16

23 × 113 =

20 × 113 = 2260

3 × 113 = 339

23 × 113 = 2599

Expanded method

Column method:

	2	7	4	1
×				6
1	6	4	4	6
	4	2		

124 × 26 becomes

	1	2	4	
×		2	6	
	7	4	4	
2	4	8	0	
3	2	2	4	
1	1			

Problem Solving
Teachers should ensure that pupils have the opportunity to apply their knowledge in a variety of contexts and problems (exploring cross curricular links) to deepen their understanding.

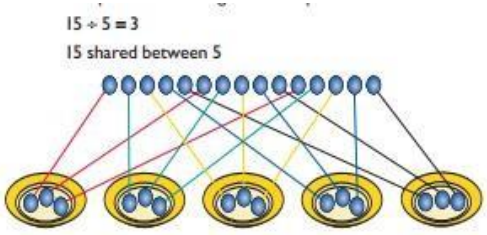
Year 1 Division

Children must have secure counting skills- being able to confidently count in 2s, 5s and 10s. Children should be given opportunities to reason about what they notice in number patterns.

Group AND share small quantities to 10- understanding the difference between the two concepts.

Sharing

Develops importance of one-to-one correspondence.

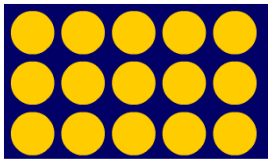


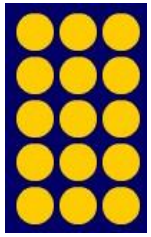
Children should be taught to share using concrete apparatus.

Grouping

Children should apply their counting skills to develop some understanding of grouping.
How many groups of 2 in 6?

Arrays as a pictorial representation can be used for division. 15 ÷ 3 = 5 There are 5 groups of 3.
15 ÷ 5 = 3 here are 3 groups of 5.





Children should be able to find ½ of shapes, objects, numbers and quantities.

Year 2 Division

Know and understand sharing and grouping- introducing children to the ÷ sign.

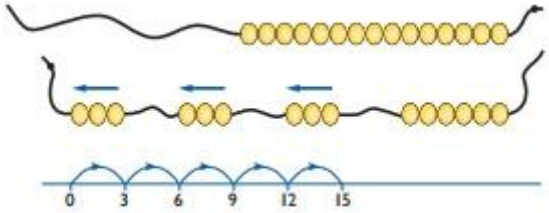
Recall and use division facts for the 2, 5 and 10 multiplication tables

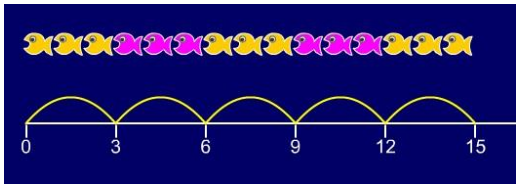
Children should continue to use grouping and sharing for division (dividends below 20) using practical apparatus, arrays and pictorial representations.

Progress to Grouping using a numberline

Group from zero in jumps of the divisor to find out 'how many groups of 3 are there in 15?'.

15 ÷ 3 = 5



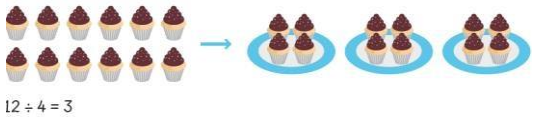


Continue work on arrays. Support children to understand how multiplication and division are inverse.
Look at an array – what do you see?
Remainders can be introduced.

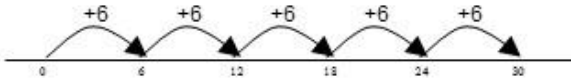
Year 3 Division

Recall and use division facts for the 3, 4 and 8 multiplication tables

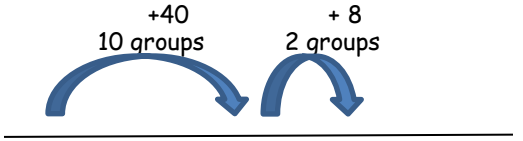
Children should continue to use grouping and sharing for division using practical apparatus, arrays and pictorial representations.



Place value counters, arrays and number lines can be used to support children apply their knowledge of grouping.



Children need to be able to partition the dividend in different ways.
48 ÷ **4** = **12**



÷ = signs and missing numbers

Continue using a range of equations as in year 2 but with appropriate numbers.

Year 4 Division

Recall division facts for the multiplication tables up to 12 x 12

Sharing, Grouping, Repeated Subtraction and Inverse

Children will continue to explore division as sharing , grouping, repeated subtraction and inverse until they have a secure understanding. Continue to use pictorial representations and Bar Method to solve word problems in context.

Children should progress in their use of written division calculations:

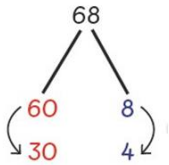
- Using tables facts with which they are fluent
- Experiencing a logical progression in the numbers they use, for example:

1. Dividend just over 10x the divisor, e.g. 84 ÷ 7
2. Dividend just over 10x the divisor when the divisor is a teen number, e.g. 173 ÷ 15 (learning sensible strategies for calculations such as 102 ÷ 17)
3. Dividend over 100x the divisor, e.g. 840 ÷ 7
4. Dividend over 20x the divisor, e.g. 168 ÷ 7

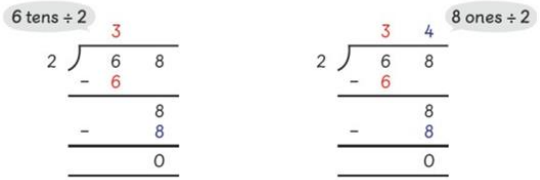
All of the above stages should include calculations with remainders as well as without. Remainders should be interpreted according to the context. (i.e. rounded up or down to relate to the answer to the problem)

Formal Written Methods

Children to use partitioning to divide 2 and 3 digit numbers e.g 68 ÷ 2 = 34



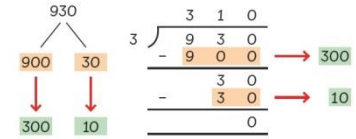
Introduce Bus Stop Method:

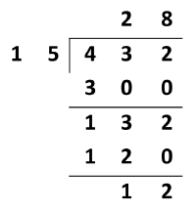


Year 5 Division

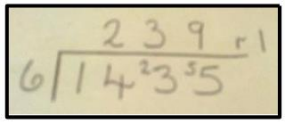
Formal Written Methods

Continue to use partitioning, number bonds and place value counters to support the efficient use of a formal long division method





Children begin to practically develop their understanding of how to express the remainder as a decimal or a fraction. Ensure practical understanding allows children to work through this (e.g. What could I do with this remaining 1? How could I share this between 6 as well?)



Year 6 Division

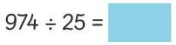
Sharing, Grouping, Repeated Subtraction and Inverse

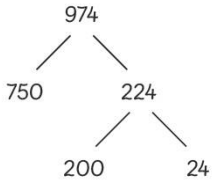
Children will continue to explore division as sharing , grouping, repeated subtraction and inverse and to represent problems using the Bar Method if appropriate.

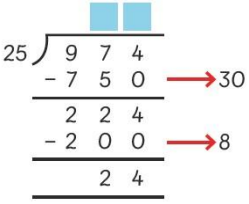
Quotients (results of division) should be interpreted appropriately for the context as a whole number, remainders, decimal or fraction.

Formal Written Methods – long and short division

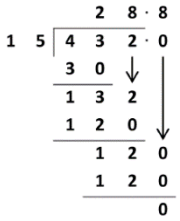
Continue to use partitioning, number bonds and place value counters to support the efficient use of long and short division methods including expressing remainder as a fraction or decimal







$974 \div 25 = 38\frac{24}{25} = 38\frac{96}{100} = 38.96$



Problem Solving

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