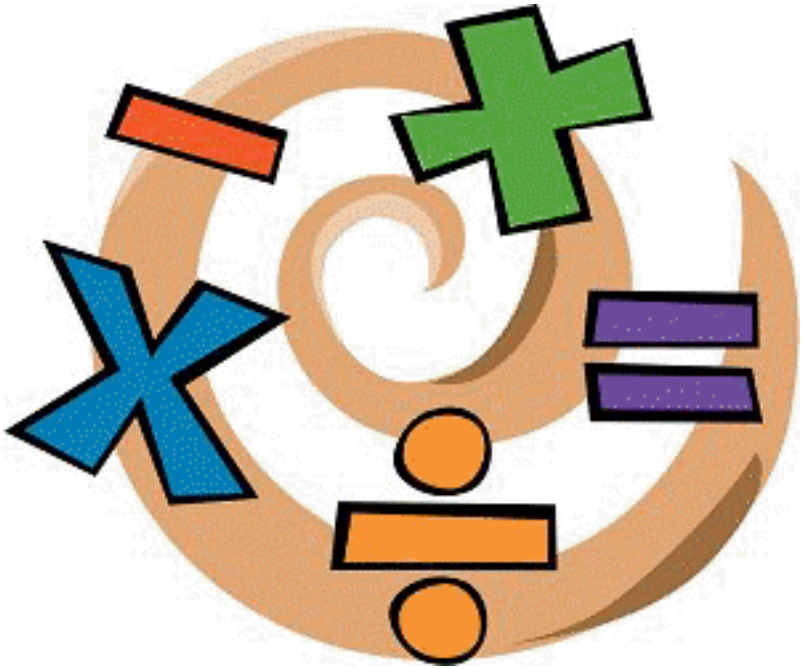
Calculations Policy for Foundation, Key Stage 1 and Key Stage 2

Maltby Redwood Academy

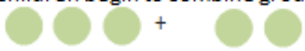
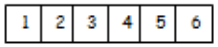
Every Child an Achiever



The Maltby Learning Trust

Addition

Foundation Stage

GUIDANCE / MODELS AND IMAGES	KEY VOCABULARY
If available, Numicon shapes are introduced straight away and can be used to: • identify 1 more/less • combine pieces to add. • find number bonds. • add without counting.  Children can record this by printing or drawing around Numicon pieces. Children begin to combine groups of objects using concrete apparatus  Construct number sentences verbally or using cards to go with practical activities. Children are encouraged to read number sentences aloud in different ways "Three add two equals 5" "5 is equal to three and two" Children make a record in pictures, words or symbols of addition activities already carried out. Solve simple problems using fingers  5 + 1 = 6 Number tracks can be introduced to count up on and to find one more:  What is 1 more than 4? 1 more than 13? Number lines can then be used alongside number tracks and practical apparatus to solve addition calculations and word problems.  **Children will need opportunities to look at and talk about different models and images as they move between representations.**	**Games and songs can be a useful way to begin using vocabulary involved in addition e.g.** Alice the Camel add more and make sum total altogether score double one more, two more, ten more… how many more to make…? how many more is… than…?

Year 1

+ = 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

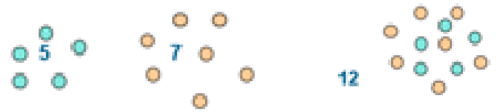
Missing numbers need to be placed in all possible places.

3 + 4 = □ □ = 3 + 4

3 + □ = 7 7 = □ + 4

Counting and Combining sets of Objects

Combining two sets of objects (aggregation) which will progress onto adding on to a set (augmentation)



Understanding of counting on with a numbertrack.

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

7+ 4

Use numicon to recall number bonds up to 20.

Introduce bar method for addition (see bar model)

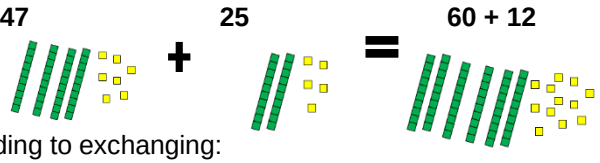
Year 2

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

Teach partitioning of 2 digit numbers and using dienes to represent this. Move onto drawing the dienes to represent the values.

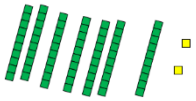
Partitioning in different ways and recombine

47+25



Leading to exchanging:

72



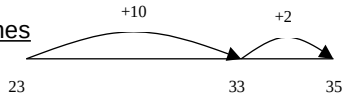
It is valuable to use a range of representations (also see Y1). Continue to use numberlines to develop understanding of:

Counting on in tens and ones

23 + 12 = 23 + 10 + 2

= 33 + 2

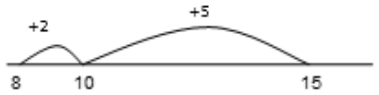
= 35



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 t

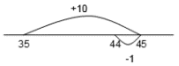
8 + 7 = 15



Adding 9 or 11 by adding 10 and adjusting by 1

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

35 + 9 = 44



Use this method along slide manipulatives to ensure understanding.

Expanded written method

40 + 7 + 20 + 5 =

40+20 + 7 + 5 =

60 + 12 = 72

40 + 7
+ 20 + 5
60 + 12 = 72

Year 3

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

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

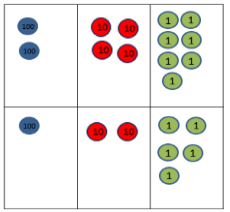
= 367 + 5

= 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

Introduce expanded column addition modelled with place value counters (Dienes could be used for those who need a less abstract representation)



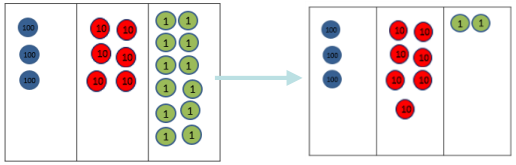
200 + 40 + 7

100 + 20 + 5

300 + 60 +12 = 372

247
+125
12
60
300
372

Leading to children understanding the exchange between tens and ones.



Some children may begin to use a formal columnar algorithm, initially introduced alongside the expanded method. The formal method should be seen as a more streamlined version of the expanded method, not a new method.

247
+125
372
10

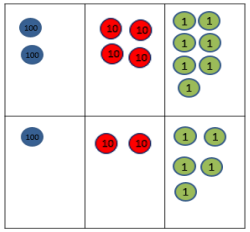
Year 4

Missing number/digit problems:

Mental methods should continue to develop, supported by a range of models and images, including the number line. The bar model should continue to be used to help with problem solving.

Written methods (progressing to 4-digits)

Expanded column addition modelled with place value counters, progressing to calculations with 4-digit numbers.

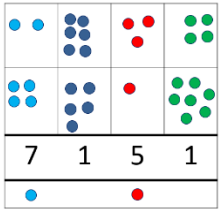


200 + 40 + 7
100 + 20 + 5
300 + 60 +12 = 372

247
+125
12
60
300
372

Compact written method

Extend to numbers with at least four digits.



2634
+4517
7151
1 1

Children should be able to make the choice of reverting to expanded methods if experiencing any difficulty.

Extend to up to two places of decimals (same number of decimals places) and adding several numbers (with different numbers of digits).

72.8
+ 54.6
127.4
1 1

Year 5

Missing number/digit problems:

Mental methods should continue to develop, supported by a range of models and images, including the number line. The bar model should continue to be used to help with problem solving. Children should practise with increasingly large numbers to aid fluency
e.g. 12462 + 2300 = 14762

Written methods (progressing to more than 4-digits)

As year 4, progressing when understanding of the expanded method is secure, children will move on to the formal columnar method for whole numbers and decimal numbers as an efficient written algorithm.

172.83
+ 54.68
227.51
1 1 1

Place value counters can be used alongside the columnar method to develop understanding of addition with decimal numbers.

Year 6

Missing number/digit problems:

Mental methods should continue to develop, supported by a range of models and images, including the number line. The bar model should continue to be used to help with problem solving.

Written methods

As year 5, progressing to larger numbers, aiming for both conceptual understanding and procedural fluency with columnar method to be secured.
Continue calculating with decimals, including those with different numbers of decimal places

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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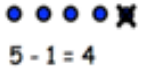
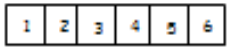
Subtraction

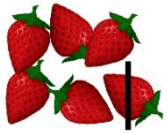
Foundation Stage

GUIDANCE / MODELS AND IMAGES	KEY VOCABULARY
Children begin with mostly pictorial representations XXX XX Concrete apparatus is used to relate subtraction to taking away and counting how many objects are left. Concrete apparatus models the subtraction of 2 objects from a set of 5.  5 - 1 = 4 Construct number sentences verbally or using cards to go with practical activities. Children are encouraged to read number sentences aloud in different ways "five subtract one leaves four" "four is equal to five subtract one" Children make a record in pictures, words or symbols of subtraction activities already carried out. Solve simple problems using fingers  5 - 1 = 4 Number tracks can be introduced to count back and to find one less:  What is 1 less than 9? 1 less than 20? Number lines can then be used alongside number tracks and practical apparatus to solve subtraction calculations and word problems. Children count back under the number line.  **Children will need opportunities to look at and talk about different models and images as they move between representations.**	**Games and songs can be a useful way to begin using vocabulary involved in subtraction e.g.** Five little men in a flying saucer take (away) leave how many are left/left over? how many have gone? one less, two less... ten less... how many fewer is... than...? difference between is the same as

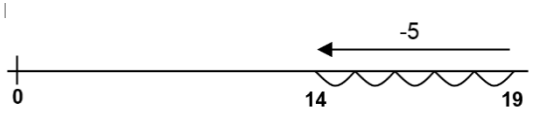
Year 1

Missing number problems e.g. 7 = □ - 9; 20 - □ = 9; 15 – 9 = □; □ - □ = 11; 16 – 0 = □
Use concrete objects and pictorial representations. If appropriate, progress from using number lines with every number shown to number lines with significant numbers shown.

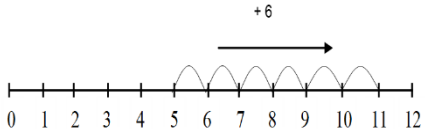
Understand subtraction as take-away:



Understand subtraction as finding the difference:



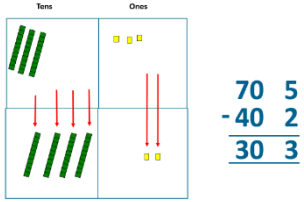
Using images to understand calculations (see bar model) The use of other images is also valuable for modelling subtraction e.g. Numicon, bundles of straws, Dienes apparatus, multi-link cubes, bead strings



Year 2

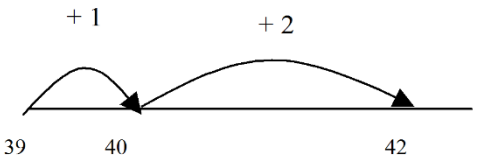
Missing number problems e.g. 52 – 8 = □; □ – 20 = 25; 22 = □ – 21; 6 + □ + 3 = 11

Recording addition and subtraction in expanded columns can support understanding of the quantity aspect of place value and prepare for efficient written methods with larger numbers. The numbers may be represented with Dienes apparatus. E.g. 75 – 42

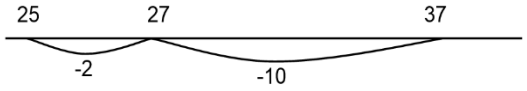


70 5
-40 2
30 3

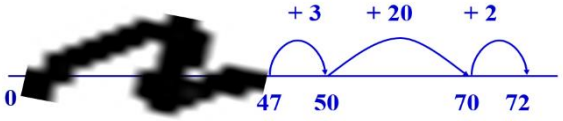
It is valuable to use a range of representations (also see Y1). Continue to use number lines to model take-away and difference. E.g.



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.



Use manipulatives alongside this blank number line method. The bar model should continue to be used, as well as images in the context of **measures**.

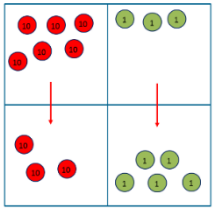


Year 3

Missing number problems e.g. □ = 43 – 27; 145 – □ = 138; 274 – 30 = □; 245 – □ = 195; 532 – 200 = □; 364 – 153 = □

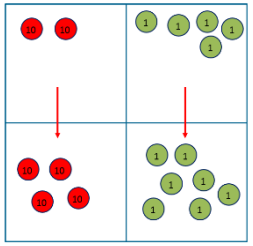
Mental methods should continue to develop, supported by a range of models and images, including the number line. The bar model should continue to be used to help with problem solving (see Y1 and Y2).
Children should make choices about whether to use complementary addition or counting back, depending on the numbers involved.

Written methods (progressing to 3-digits)
Introduce expanded column subtraction with no decomposition, modelled with place value counters (Dienes could be used for those who need a less abstract representation)



90 8
-30 5
60 3

For some children this will lead to exchanging, modelled using place value counters (or Dienes).



60
70 ¹2
-40 7
20 5

A number line and expanded column method may be compared next to each other.

Some children may begin to use a formal columnar algorithm, initially introduced alongside the expanded method. The formal method should be seen as a more streamlined version of the expanded method, not a new method.

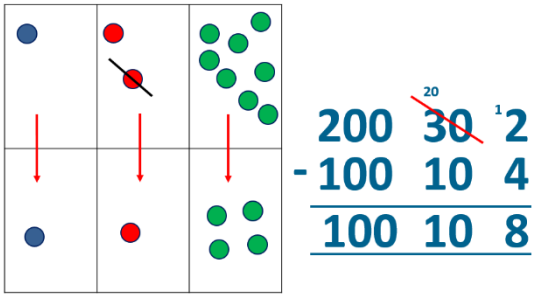
Year 4

Missing number/digit problems: 456 + □ = 710; 1□7 + 6□ = 200; 60 + 99 + □ = 340; 200 – 90 – 80 = □; 225 - □ = 150; □ – 25 = 67; 3450 – 1000 = □; □ - 2000 = 900

Mental methods should continue to develop, supported by a range of models and images, including the number line. The bar model should continue to be used to help with problem solving.

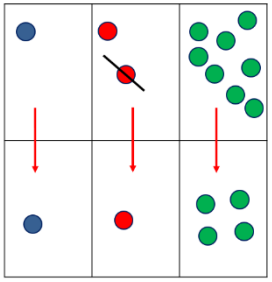
Written methods (progressing to 4-digits)

Expanded column subtraction with decomposition, modelled with place value counters, progressing to calculations with 4-digit numbers.



$$\begin{array}{rrrr} 200 & \cancel{30}^{20} & {}^{1}2 \\ -\,100 & 10 & 4 \\ \hline 100 & 10 & 8 \end{array}$$

If understanding of the expanded method is secure, children will move on to the formal method of decomposition, which again can be initially modelled with place value counters.



$$\begin{array}{r} {}^{2}\cancel{3}^{1}2 \\ -\,114 \\ \hline 118 \end{array}$$

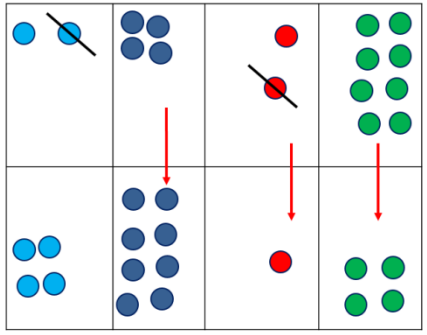
Year 5

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 = □

Mental methods should continue to develop, supported by a range of models and images, including the number line. The bar model should continue to be used to help with problem solving.

Written methods (progressing to more than 4-digits)

When understanding of the expanded method is secure, children will move on to the formal method of decomposition, which can be initially modelled with place value counters.



$$\begin{array}{r} {}^{5}\cancel{6}^{1}{}^{2}\cancel{3}^{1}2 \\ -\,4814 \\ \hline 1418 \end{array}$$

Progress to calculating with decimals, including those with different numbers of decimal places.

Year 6

Missing number/digit problems: □ and # each stand for a different number. # = 34. # + # = □ + □ + #. What is the value of □? What if # = 28? What if # = 21

10 000 000 = 9 000 100 + □

7 – 2 x 3 = □; (7 – 2) x 3 = □; (□ - 2) x 3 = 15

Mental methods should continue to develop, supported by a range of models and images, including the number line. The bar model should continue to be used to help with problem solving.

Written methods

As year 5, progressing to larger numbers, aiming for both conceptual understanding and procedural fluency with decomposition to be secured.

Continue calculating with decimals, including those with different numbers of decimal places.

$$\begin{array}{r} {}^{3}\cancel{4}^{9}0{}^{11}\cancel{2}^{10}\cancel{.}{}^{10}1\cancel{0} \\ -\,243.86 \\ \hline 158.24 \end{array}$$

Multiplication

Foundation Stage

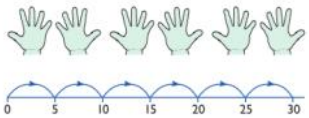
GUIDANCE / MODELS AND IMAGES	KEY VOCABULARY
The link between addition and multiplication can be introduced through doubling. If available, Numicon is used to visualise the repeated adding of the same number. These can then be drawn around or printed as a way of recording. Children begin with mostly pictorial representations:   How many groups of 2 are there? Real life contexts and use of practical equipment to <u>count in repeated groups of the same size</u>:  How many wheels are there altogether?  How much money do I have? Count in twos; fives; tens both aloud and with  objects Children are <u>given multiplication problems set in a real life context</u>. Children are encouraged to visualise the problem. How many fingers on two hands? How many sides on three triangles? How many legs on four ducks? Children are encouraged to read number sentences aloud in different ways "five times two makes ten" "ten is equal to five multiplied by two"	lots of groups of times multiply multiplied by multiple of once, twice, three times… ten times… …times as (big, long, wide… and so on) repeated addition double

Year 1

Understand multiplication is related to doubling and combing groups of the same size (repeated addition)

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

2 + 2 + 2 + 2 + 2 = 10
2 × 5 = 10
2 multiplied by 5
5 pairs
5 hops of 2

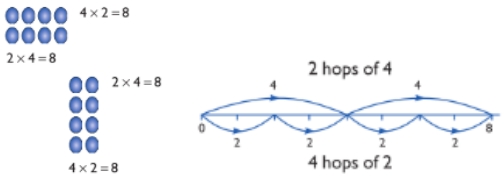


5 + 5 + 5 + 5 + 5 + 5 = 30
5 × 6 = 30
5 multiplied by 6
6 groups of 5
6 hops of 5

Problem solving with concrete objects (including money and measures

Use cuissenaire and bar method to develop the vocabulary relating to 'times' –
Pick up five, 4 times

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



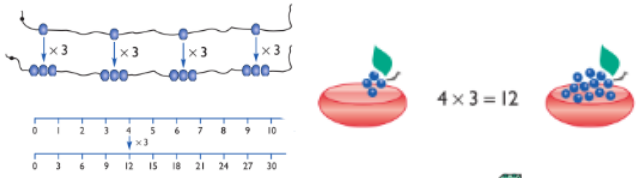
Year 2

Expressing multiplication as a number sentence using x
Using understanding of the inverse and practical resources to solve missing number problems.

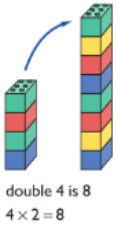
7 x 2 = □ □ = 2 x 7
7 x □ = 14 14 = □ x 7
□ x 2 = 14 14 = 2 x □
□ⓧ = 14 14 = □ⓧ

Develop understanding of multiplication using array and number lines (see Year 1). Include multiplications not in the 2, 5 or 10 times tables.

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

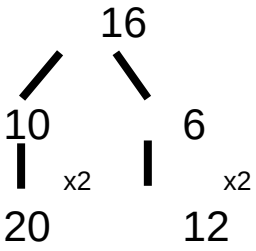


Doubling numbers up to 10 + 10
Link with understanding scaling
Using known doubles to work out double 2d numbers
(double 15 = double 10 + double 5)



Towards written methods

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



Year 3

Missing number problems
Continue with a range of equations as in Year 2 but with appropriate numbers.

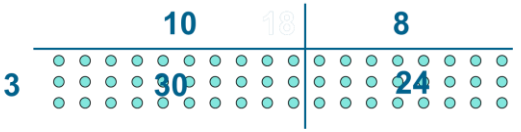
Mental methods
Doubling 2 digit numbers using partitioning

Demonstrating multiplication on a number line – jumping in larger groups of amounts

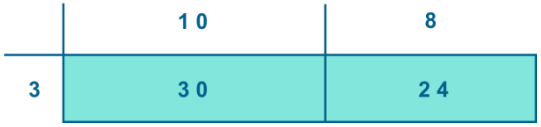
13 x 4 = 10 groups 4 = 3 groups of 4

Written methods (progressing to 2d x 1d)

Developing written methods using understanding of visual images

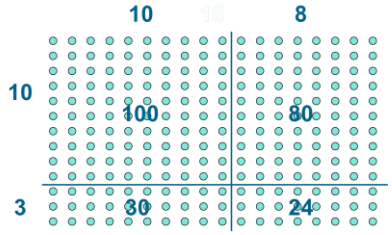
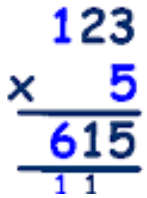
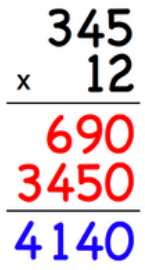
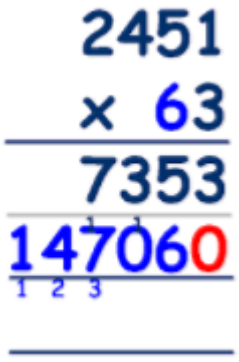


Develop onto the grid method



Give children opportunities for children to explore this and deepen understanding using Dienes apparatus and place value counters.

Some children may progress onto the formal method for multiplication.

Year 4	Year 5	Year 6
Continue with a range of equations as in Year 2 but with appropriate numbers. Also include equations with missing digits □2 x 5 = 160 **Mental methods** Counting in multiples of 6, 7, 9, 25 and 1000, and steps of 1/100. Solving practical problems where children need to scale up. Relate to known number facts. (e.g. how tall would a 25cm sunflower be if it grew 6 times taller?) **Written methods (progressing to 3d x 2d)** Children to embed and deepen their understanding of the grid method to multiply up 2d x 2d. Ensure this is still linked back to their understanding of arrays and place value counters.  Some children may progress onto the formal method for multiplication.  	Continue with a range of equations as in Year 2 but with appropriate numbers. Also include equations with missing digits **Mental methods** X by 10, 100, 1000 using moving digits ITP Use practical resources and jottings to explore equivalent statements (e.g. 4 x 35 = 2 x 2 x 35) Recall of prime numbers up 19 and identify prime numbers up to 100 (with reasoning) Solving practical problems where children need to scale up. Relate to known number facts. Identify factor pairs for numbers **Written methods (progressing to 4d x 2d)** Long multiplication using place value counters Children to explore how the grid method supports an understanding of long multiplication (for 2d x 2d)   	Continue with a range of equations as in Year 2 but with appropriate numbers. Also include equations with missing digits **Mental methods** Identifying common factors and multiples of given numbers Solving practical problems where children need to scale up. Relate to known number facts. **Written methods** Continue to refine and deepen understanding of written methods including fluency for using long multiplication Children to use methods to multiply decimals.

Division

Foundation Stage

GUIDANCE / MODELS AND IMAGES	KEY VOCABULARY
The ELG states that children **solve problems, including doubling, halving and sharing.** Children need to see and hear representations of division as both grouping and sharing. Division can be introduced through halving. Children begin with mostly pictorial representations linked to real life contexts:  **Grouping model** Mum has 6 socks. She grouped them into pairs – how many pairs did she make?  **Sharing model** I have 10 sweets. I want to share them with my friend. How many will we have each? Children have a go at recording the calculation that has been carried out.	halve share, share equally one each, two each, three each… group in pairs, threes… tens equal groups of divide divided by divided into left, left over

FRACTIONS

GUIDANCE / MODELS AND IMAGES	KEY VOCABULARY
Although not explicit in the Development Matters document, the sharing model is a useful way of introducing young children to fractions and calculating with fractions. Setting the problems in real life context and solving them with concrete apparatus will support children's understanding. "I have got 5 bones to share between my two dogs. How many bones will they get each?"  Children have a go at recording the calculation that has been carried out. 2 ½ + 2 ½ = 5	As division vocabulary plus: fraction half halves third thirds

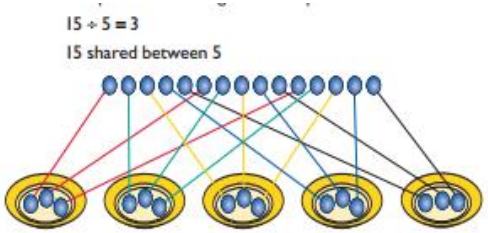
Year 1

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- understanding the difference between the two concepts.**

Sharing

Develops importance of one-to-one correspondence.

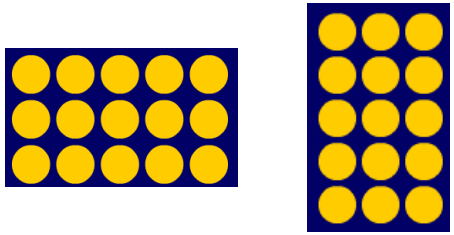


Children should be taught to share using concrete apparatus.

Grouping

Children should apply their counting skills to develop some understanding of grouping.

Use of arrays as a pictorial representation for division. 15 ÷ 3 = 5 There are 5 groups of 3.
15 ÷ 5 = 3 There are 3 groups of 5.



Children should be able to find ½ and ¼ and simple fractions of objects, numbers and quantities.

Year 2

÷ = signs and missing numbers

6 ÷ 2 = □ □ = 6 ÷ 2
6 ÷ □ = 3 3 = 6 ÷ □
□ ÷ 2 = 3 3 = □ ÷ 2
□ ÷ ∇ = 3 3 = □ ÷ ∇

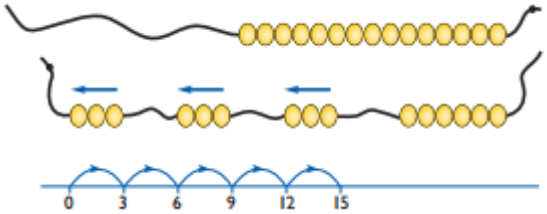
Know and understand sharing and grouping- introducing children to the ÷ sign.

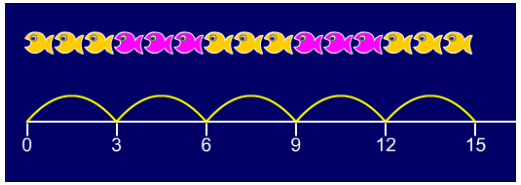
Children should continue to use grouping and sharing for division using practical apparatus, arrays and pictorial representations.

Grouping using a numberline

Group from zero in jumps of the divisor to find our '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?

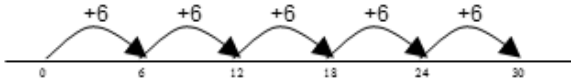
Year 3

÷ = signs and missing numbers

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

Grouping

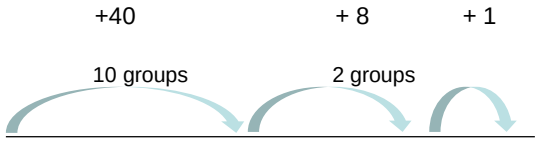
How many 6's are in 30?
30 ÷ 6 can be modelled as:



Becoming more efficient using a numberline

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

Remainders
49 ÷ 4 = 12 r1



Sharing – 49 shared between 4. How many left over?
Grouping – How many 4s make 49. How many are left over?

Place value counters can be used to support children apply their knowledge of grouping.
For example:
60 ÷ 10 = How many groups of 10 in 60?
600 ÷ 100 = How many groups of 100 in 600?

Year 4

÷ = signs and missing numbers

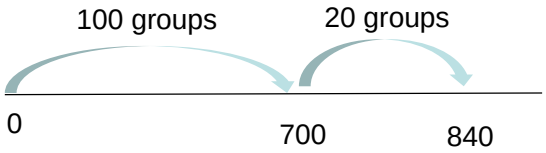
Continue using a range of equations as in year 3 but with appropriate numbers.

Sharing, Grouping and using a number line

Children will continue to explore division as sharing and grouping, and to represent calculations on a number line until they have a secure understanding. 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:



Jottings

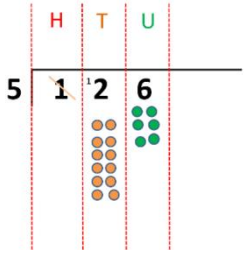
7 x 100 = 700

7 x 10 = 70

7 x 20 = 140

Formal Written Methods

Formal short division should only be introduced once children have a good understanding of division, its links with multiplication and the idea of 'chunking up' to find a target number (see use of number lines above)



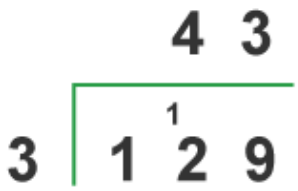
Short division to be modelled for understanding using place value counters as shown below. Calculations with 2 and 3-digit dividends. E.g. fig 1

Year 5

Formal Written Methods

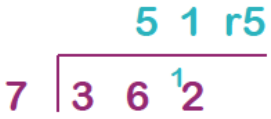
Continued as shown in Year 4, leading to the efficient use of a formal method. The language of grouping to be used (see link from fig. 1 in Year 4)

E.g. 1435 ÷ 6



Children begin to practically develop their understanding of how 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?)

362 ÷ 7 =



Year 6

÷ = signs and missing numbers

Continue using a range of equations but with appropriate numbers

Sharing and Grouping and using a number line

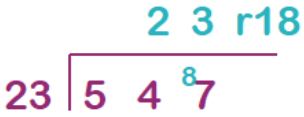
Children will continue to explore division as sharing and grouping, and to represent calculations on a number line as appropriate.

Quotients should be expressed as decimals and fractions

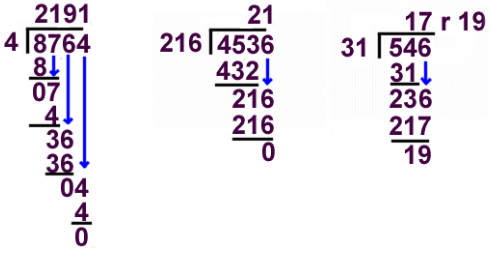
Formal Written Methods – long and short division

Short method

547 ÷ 23 =



Long Method

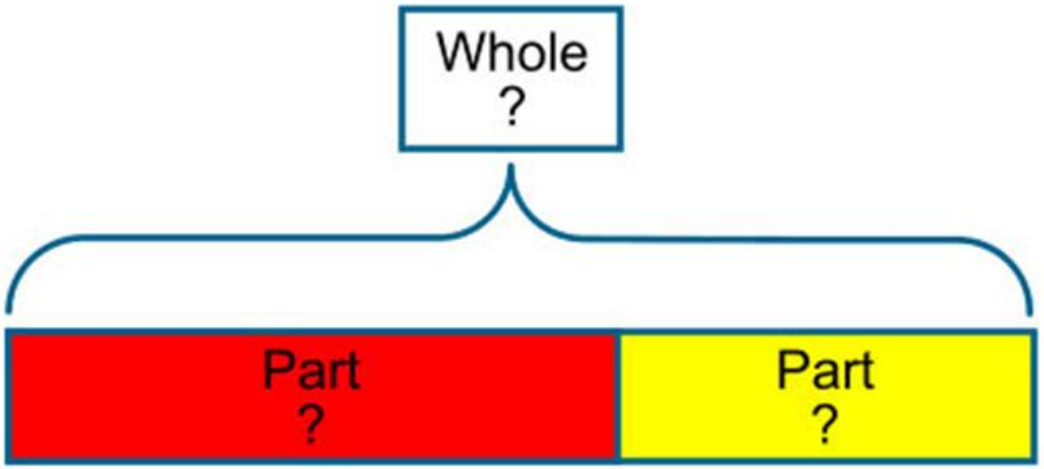


Progression of Bar Modelling

Sam had 10 red marbles and 12 blue marbles. How many marbles did he have altogether?

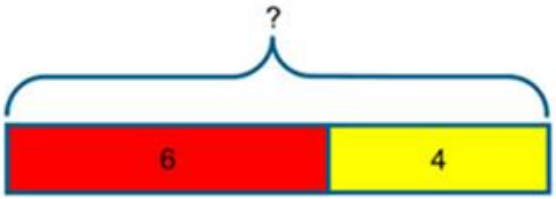
10 + 12 = 22

In problems involving addition and subtraction there are three possible unknowns as illustrated below and given the value of two of them the third can be found.



The examples below illustrate a variety of ways that the bar might be used for addition and subtraction problems. A question mark is used to indicate the part that is unknown.

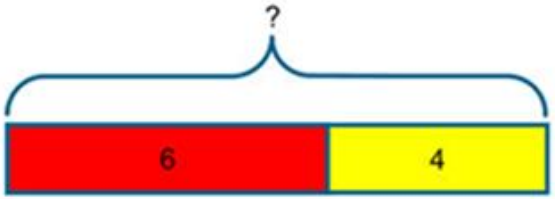
Addition
Aggregation
- two quantities combined



I have 6 red pencils and 4 yellow pencils. How many pencils do I have?

(I combine two quantities to form the whole)

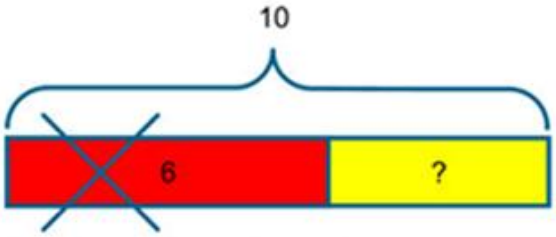
Addition
Augmentation
- a quantity is increased



I have 6 red pencils and I buy 4 yellow pencils. How many pencils do I have?

(The bar I started with increases in length)

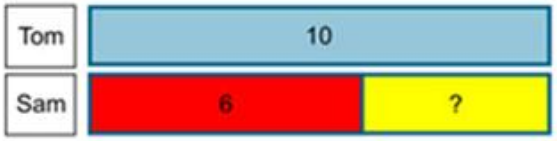
Subtraction
- Take Away



I had 10 pencils and I gave 6 away, how many do I have now?

(This time we know the whole but only one of the parts, so the whole is partitioned and one of the parts removed to identify the missing part)

Subtraction
- Comparison or Difference

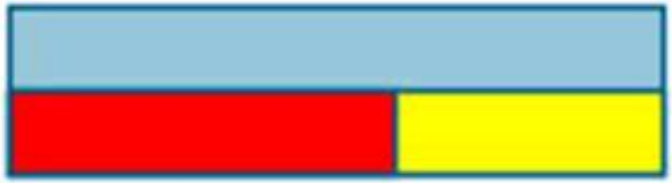


Tom has 10 pencils and Sam has 6 pencils. How many more does Tom have?

(The bar is particularly valuable for seeing the difference between the two quantities)

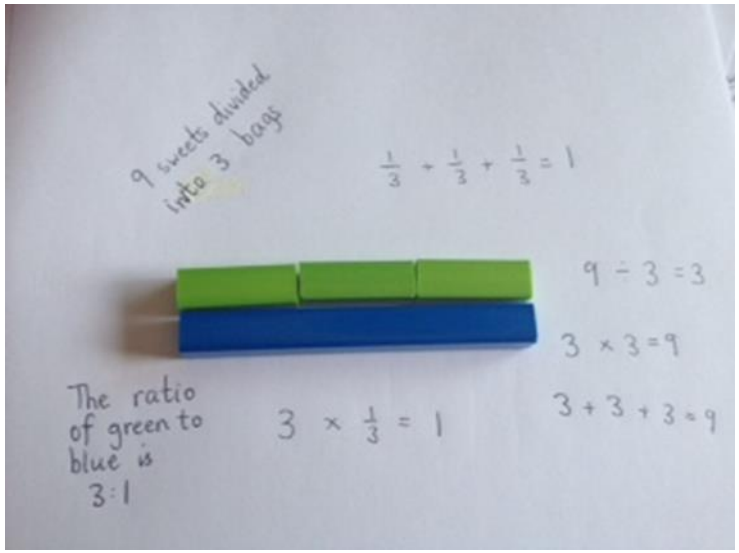
Equivalence

The model can be rearranged to demonstrate equivalence in a traditional layout



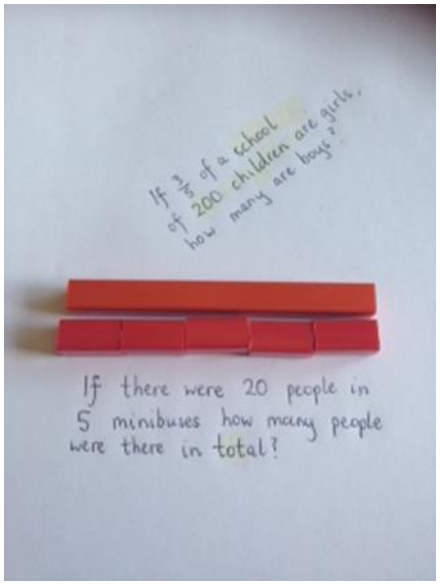
Pupils need to develop fluency in using this structure to represent addition and subtraction problems in a variety of contexts using the bar model. The model will help children to see that different problems share the same mathematical structure and can be visualised in the same way. Asking children to write their own problems, using the bar as the structure will help to consolidate this understanding.

Milking the maths: using the bar model flexibly across all year groups:

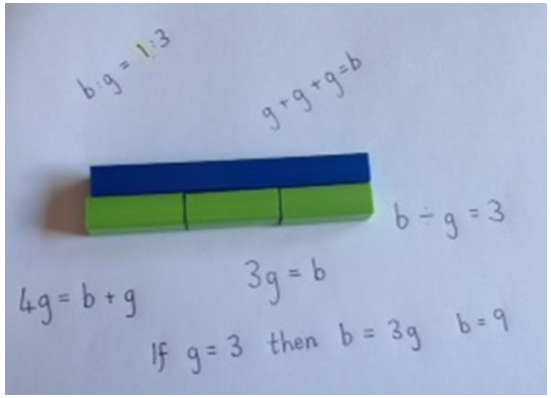


What could this bar model be showing?

Can you design questions that fit the bar model?



Playing with algebra



Cuisenaire rods and numicon should be used by children at this stage, so that the gap is bridged between using concrete objects and drawing symbolic representations of objects. We would expect children to be working practically with Cuisenaire and talking about relations, so that they are then ready to start drawing bar model representations in lower Key-Stage 2.

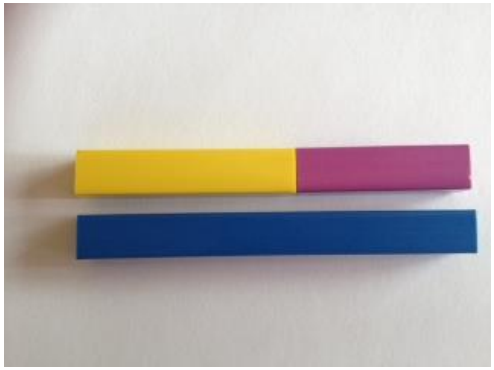
National Curriculum Objectives: Rapid Recall

Year 1: represent and use number bonds and related subtraction facts within 20
Year 2: recall and use addition and subtraction facts to 20 fluently, and derive and use related facts up to 100

National Curriculum Objectives: Addition and Subtraction

Year 2: show that addition of two numbers can be done in any order (commutative) and subtraction of one number from another cannot

Focus on verbalising thinking:
e.g.
'five add four is equal to nine'
'four add five is equal to nine'
'nine take-away four equals five'
'nine take away five equals four'



For teacher's understanding, children would not be expected to write the above algebraic notations.

Addition and Subtraction

The bar model supports understanding of the relationship between addition and subtraction in that both can be seen within the one representation and viewed as different ways of looking at the same relationships.

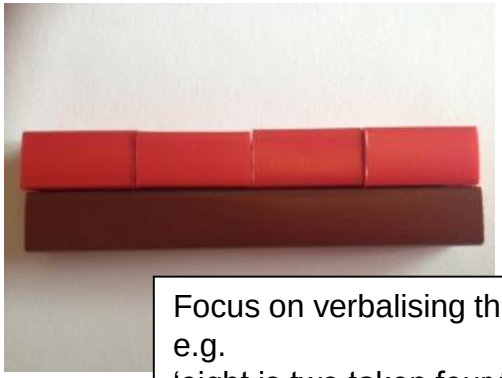
This diagram encapsulates all of the following relationships;

$a = b + c$; $a + c + b$; $a - b = c$; $a - c = b$

National Curriculum Objectives: Multiplication and Division

Year 1: solve one-step problems involving multiplication and division, by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher.

Focus on verbalising thinking:
e.g.
'eight is two taken four times'
'two taken four times is eight'
'eight equals four times two'
'there are four twos in eight'



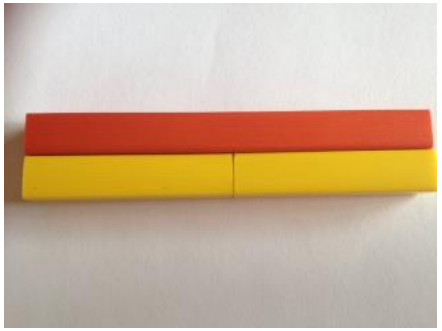
Focus on verbalising thinking:
e.g.
'eight is two taken four times'
'two taken four times is eight'
'eight equals four times two'
'there are four twos in eight'

Year 2: solve problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in contexts.
[Photograph of Cuisenaire being used as a bar model and arrays.]

National Curriculum Objectives: Fractions

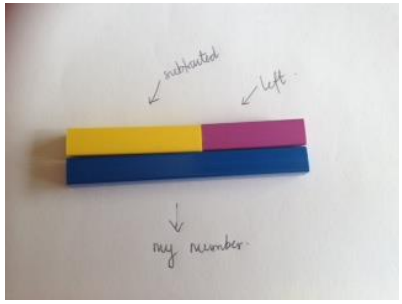
Year 1: recognise, find and name a half as one of two equal parts of an object, shape or quantity
recognise, find and name a quarter as one of four equal parts of an object, shape or quantity.

Year 2: recognise, find, name and write fractions $^1/_3$, $^1/_4$, $^2/_4$ and $^3/_4$ of a length, shape, set of objects or quantity
write simple fractions e.g. $^1/_2$ of 6 = 3 and recognise the equivalence of $^2/_4$ and $^1/_2$.
e.g.
What fractions can you see?
What fraction of the orange is each yellow piece?
If the value of the orange rod is ten, what is the value of each yellow rod?
Extension: What if the value of the orange rod is 6? 100? Etc.



National Curriculum Objectives: Problem Solving

Year 1: solve one-step problems that involve addition and subtraction, using concrete objects and pictorial representations, and missing number problems such as 7 = □ - 9.



Year 2: solve problems with addition and subtraction:

- using concrete objects and pictorial representations, including those involving numbers, quantities and measures
- applying their increasing knowledge of mental and written methods

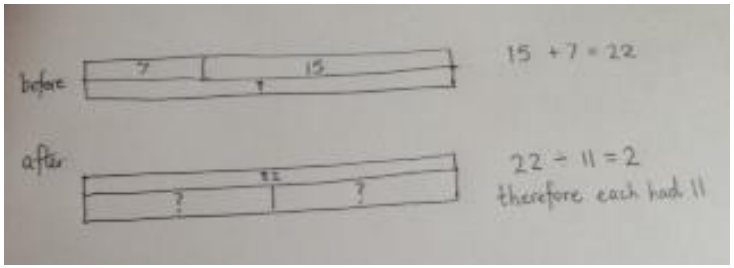
e.g.
I think of a number. I subtract 5. The answer is 4. What is my number?

e.g.
A tub contains 24 coins. Saj takes 5 coins. Joss takes 10 coins. How many coins are left in the tub?

Children should now be ready to start drawing bar model representations. For the purpose of this progression document, we have modelled 'before' and 'after' representations of problems. It may, however, be that schools instead choose to use a model whereby the first representation is developed.

e.g.

Aiden has seven marbles and Harvey has fifteen. They decide to share them equally between them. How many do they get each?

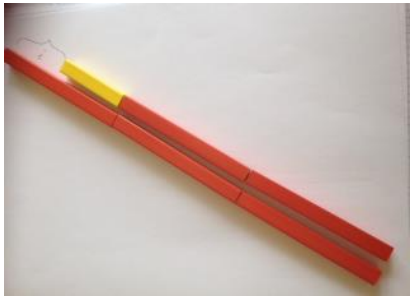


National Curriculum Objectives: Problem Solving in Addition and Subtraction

Year 3: solve problems, including missing number problems, using number facts, place value, and more complex addition and subtraction.

Year 4: solve addition and subtraction two-step problems in contexts, deciding which operations and methods to use and why.

- e.g. one-step problem
- Sally has 40 football cards. She gives 25 of them away. How many does she give away?



National Curriculum Objectives: Problem Solving in Multiplication and Division

Year 3: solve problems, including missing number problems, involving multiplication and division, including integer scaling problems and correspondence problems in which n objects are connected to m objects.
This is an example of integer scaling.

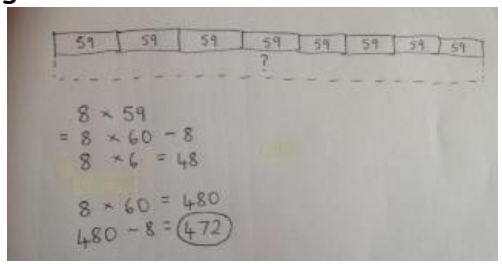
Peter has 4 books
Harry has five times as many books as Peter.
How many books has Harry?

4

4 4 4 4 4

4 × 5 = 20
Harry has 20 books

Year 4: solve problems involving multiplying and adding, including using the distributive law to multiply two digit numbers by one digit, integer scaling problems and harder correspondence problems such as n objects are connected to m objects.
e.g. 8 children each download 59 songs to play on their iPod. How many songs do they have altogether?



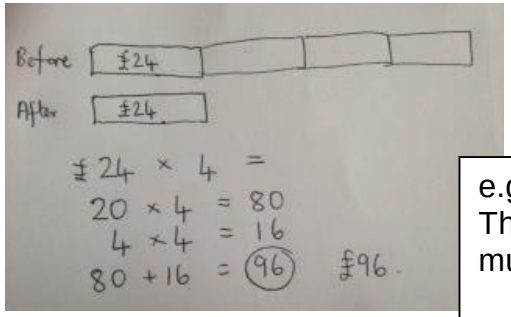
National Curriculum Objectives: Fractions

Year 3: solve problems that involve (unit fractions and fractions with the same denominator)

Year 4: solve problems involving increasingly harder fractions to calculate quantities, and fractions to divide quantities, including non-unit fractions where the answer is a whole number

Year 4: solve simple measure and money problems involving fractions and decimals to two decimal places, including decimals

e.g. A computer game is £24 in the sale. This is one quarter of its original price. How much did it cost before the sale?



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Cuisenaire and double-sided counters are still valuable resources to use alongside drawn representations of problems. They should all be used flexibly according to the stage that children have reached in their learning.

National Curriculum Objectives: Problem Solving in Addition and Subtraction

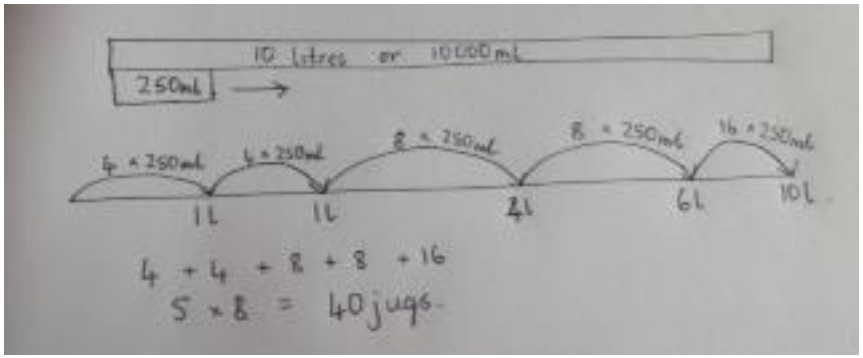
Year 5: solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why

Year 6: solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why

National Curriculum Objectives: Problem Solving in Multiplication and Division

Year 5: solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates

e.g. How many jugs with a capacity of 250ml could you fill with 10 litres of water?

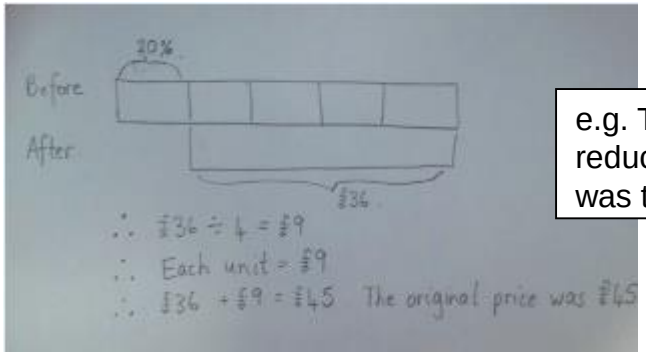


National Curriculum Objectives: Fractions

Year 5: solve problems which require knowing percentage and decimal equivalents of $^1/_2$, $^1/_4$, $^1/_5$, $^2/_5$, $^4/_5$ and those with a denominator of a multiple of 10 or 25, including decimals and percentages

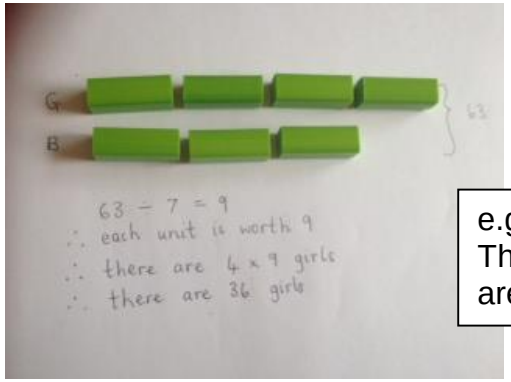
Year 6: solve problems which require answers to be rounded to specified degrees of accuracy, including decimals and percentages

e.g. There is 20% off in a sale. The reduced price of the jeans is £36. What was the original price?



e.g. There is 20% off in a sale. The reduced price of the jeans is £36. What was the original price?

The bar model can also be linked beautifully with ratio and proportion, for example, in the following context:
e.g. At a dance there are 4 girls to every 3 boys. There are 63 children altogether? How many girls are there?



e.g. At a dance there are 4 girls to every 3 boys. There are 63 children altogether? How many girls are there?

Example Questions for Key Stage 1

Year 1 Problems

1. Ebony has 5p and Daniel has 8p. How much do they have altogether?
2. A lolly costs 6p. Amrit paid with a 10p coin. How much change does he get?
3. Michael says that 16 + 5 = 21. Is he correct?
4. I think of a number. I subtract 5. The answer is 4. What was my number?
5. How many gloves are there altogether in 6 pairs of gloves?
6. Twelve people are split into two groups. How any are in each group?
7. Mrs Morton puts five 5p coins into her purse. How much is in her purse altogether?

Year 2 Problems

1. Dylan has 37 coloured pencils and he buys 30 more. How many does he have now?
2. Janie has 40 beads. She loses 25 of them. How many does she have left?
3. What is the difference between seventy six and thirty five?
4. I think of a number. I subtract 5. The answer is 4. What was my number?
5. Last week Ellie got £1.00 pocket money. She spent half of it. How much has she got left?
6. A tub contains 24 coins. Saj takes 5 coins. Joss takes 10 coins. How many coins are left in the tub?
7. Amelia writes the calculation below as a multiplication calculation? What might she write?
3 + 3 + 3 + 3 + 3 = 15
8. Mr Siddique shares £18 equally between his three sons. How much does each son get?
9. Charlotte-May had to find a 14 of a number. Her answer was 4. What number did she start with?

10. Danny cuts his pizza into 8 equal slices. He eats 3/4 of the pizza and gives the rest to his dog, Gruff. How many pieces does Danny eat?

Example Questions for Lower Key Stage 2

Year 3 Problems

1. There are 334 children at Springfield School and 75 at Holy Trinity Nursery. How many children are there altogether?
2. Gemma collected 293 badges but she gave 45 of them to her friend, Rebecca. How many badges did she have left?
3. Aiden has seven marbles and Harvey has fifteen. They decide to share them equally between them. How many do they get each?
4. Seven people each put five pens into a pot. Carmen then takes out fifteen pens. How many pens are left?
5. If you spend 61p at the corner shop, how much change do you get from £1.00?
6. If five apples cost fifty pence, how much would two apples cost?
7. Emma buys seven markers for 30p each. How much change does she get from £3.00?
8. A bookcase in the library holds 5 shelves with 46 books on each shelf. How many books are there in the bookcase altogether?
9. How many 5p stickers can Alexis buy with his 55p pocket money?
10. Which is the larger amount, one third of £60 or one quarter of £88?
11. A computer game is £24 in the sale. This is one quarter of its original price. How much did it cost before the sale?

Year 4 Problems

1. Martin has saved £6.78 and spends £4.69. How much does he have left?
2. Sally has 40 football cards. She gives 2 fifths of them away. How many does she give away?
3. Sally has 30 football cards. She gives 2 fifths of them to her friend. How many does she have left?
4. 8 children each download 59 songs to play on their iPod. How many songs do they have altogether?
5. Calculate how many fives there are in 85?
6. At the dressmakers, Debbie buys buttons weighing 3 grams each. If she has 81 grams of buttons, how many buttons does she buy?

7. Kelly buys four fifths of the shop's oranges. If the shop had 20 oranges, how many does she have?

Example Questions for Upper Key Stage 2

Year 5 Problems

- 1. Every day for 4 days Helen scored 7.5 in a test. On the fifth day she scored 8. What was her total score?
- 2. I cut 60 cm from 3.3m of string and shared the rest between 3 friends. How much string did they get each?
- 3. How many jugs with a capacity of 250ml could you fill with 10 litres of water?
- 4. All the children in the school are going on a residential trip to the outdoor activity centre. They will be divided into 6 equal groups If there are 246 children in the school how many will be in each group?
- 5. Robert calculated 25% of 600. What answer does he get?
- 6. Sam calculated 40% of 120. What answer does he get?
- 7. Rita worked out that one sixth of a number was 12. What was the number she started with?

Year 6 Problems

- 1. Three quarters of a number is 54. What is the number?
- 2. Which is more; five ninths of 252 or four sevenths of 238?
- 3. There are 36 packets of biscuits. One half are chocolate, a ninth are digestive and a third are wafer biscuits. The rest are ginger nuts. How many biscuits are ginger nuts?
- 4. There is 20% off in a sale. How much would a track suit cost, if the normal price was £44.50?
- 5. There is 20% off in a sale. The reduced price of the jeans is £36. What was the original price?
- 6. At a dance there are 4 girls to every 3 boys. There are 63 children altogether? How many girls are there?
- 7. Seven in every nine packets of crisps in a box are salt and vinegar. The rest are plain. There are 63 packets of salt and vinegar crisps. How many packets of plain crisps are there?

Key Stage 3 Problems

1. Ralph posts 40 letters, some of which are first class, and some of which are second class.
He posts four times as many second class letters as first.
How many of each class of letter does he post? (This question appeared on a GCSE higher tier paper.)
2. A computer game was reduced in a sale by 20% and it now costs £55. What was the original cost?
3. A computer game was reduced in a sale by 30% and it now costs £77. What was the original cost?