



New City Primary School

Calculation Policy

Policy Creation and Review

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Last Review Date	July 2019
Ratified by Governing Body	
Next Review Date	July 2020

Introduction

This policy outlines both the mental and written methods that should be taught from Year 1 to Year 6. The policy has been written according to the National Curriculum 2014 and the written calculations for all four operations are as outlined on the appendices of the Programme of Study.

The document builds on the interconnectedness of mathematics and outlines the progression for addition, subtraction, multiplication and division. It is our intention that addition and subtraction should be taught at the same time to ensure children are able to see the clear links between the operations and the inverse nature of them along with multiplication and division.

Children should secure mental strategies. They are taught the strategy of counting forwards and backwards in ones and tens first and then 'Special Strategies' are introduced. Children are taught to look carefully at the calculation and decide, which strategy they should use. Children should explain and reason as to why they have chosen a strategy and whether it is the most efficient.

The formal written methods should be introduced with caution. Calculations that require a written method should be presented to the children and models and images, such as dienes apparatus, place value counters, etc. should be used to ensure children have a conceptual understanding of the written method and that it is not a process that the children use for every type of calculation regardless of whether it can be completed mentally or mentally with jotting i.e. the number line.

The policy outlines the **mental strategies** that children should be encouraged to use:

- A mental strategy that they can always rely on **E.g. counting in tens and ones, forwards and backwards E.g. $56 - 25$** (count back in 10s 56, 46, 36 and back in ones 36, 35, 34, 33, 32, 31)
- A special strategy they can select from a small range of strategies if they can see something special about the numbers they are being asked to calculate with E.g. $46 - 24$ (I can use near doubles to support my calculation E.g. $46 - 23 - 1$)

The policy outlines the **written methods** as suggested on the appendices of the Curriculum 2014 and suggests that children:

- Look at a calculation and decide whether it can be done mentally, mentally with a jotting or whether it needs a written method.
- **Should always be shown written methods with place value apparatus to ensure children are clear about the value of the numbers that they are calculating with and the numbers do not just become digits.**
- Estimate, calculate and check to ensure that the answer they generate has some meaning.

For the purpose of developing understanding there may be occasions when examples that can be completed mentally may be shown as a written method purely to develop understanding of the method. This needs to be made very clear to children and when they are practising the methods, appropriate calculations should be used.

Concrete, Visual, Abstract:

A key principle behind the Singapore Maths textbooks and Maths Mastery is based on the concrete, visual and abstract approach. Pupils are first introduced to an idea or skill by acting it out with real objects (a hands-on approach). Pupils then are moved onto the visual stage, where pupils are encouraged to relate the concrete understanding to pictorial representations. The final abstract stage is a change for pupils to represent problems by using mathematical notation. Whilst this calculation policy aims to show the CVA approach to the different calculations, it is not always noted further up the year groups. However, it is expected that the CVA approach is used continuously in all new learning and calculations even when not noted

EYFS

In EYFS pupils should be developing their concept of the number system through the use of **concrete materials and pictorial representations**. They should experience practical calculation opportunities using a wide variety of equipment, e.g. small world play, role play, counters, cubes etc. They develop ways of recording calculations using pictures, etc.

Addition: Add two single digit numbers, counting on to find the answer.

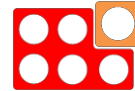
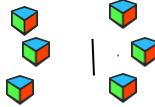
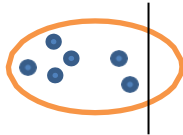
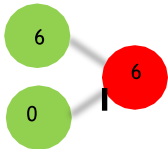
Pupils must be provided with opportunities to develop their skills so that they are able to count reliably, including one to one correspondence and count on from a given number.

Pupils should be given the opportunity to count out sets of objects and then combine them to make a total e.g. $6 + 2 = 8$



First count out a group of 6. Then count out a group of 2. Finally combine them to find a total.

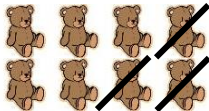
Pupils should recognise different ways of making numbers. E.g 6 can be made as



Subtraction: Using quantities and objects, subtract two single-digit numbers and count back to find the answer.

Pupils should count out a group of objects, move some away and recount the total.

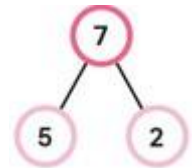
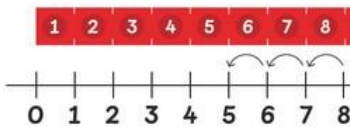
$$8 - 3 = 5$$



After pupils have recognised different ways of making numbers, they should use this number bond knowledge to help with subtraction facts.

Children should use concrete materials to start counting back in order to solve subtraction problems.

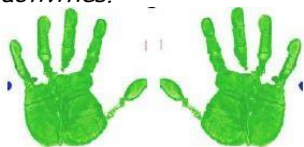
$$8 - 3 =$$



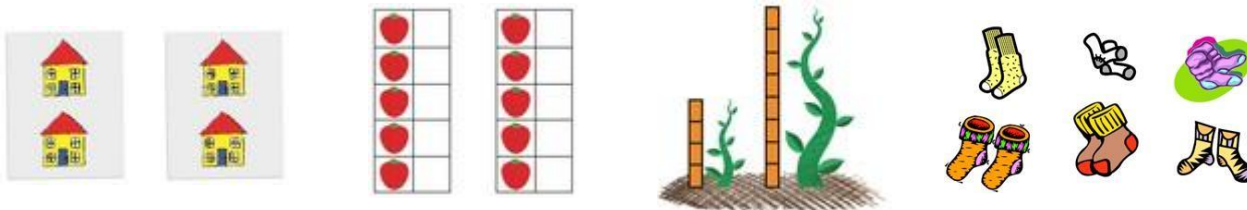
EYFS

Multiplication: Solve problems, including doubling

Children will experience equal groups of objects. They should work on practical problem solving activities.



Use a range of concrete materials to show a number and then repeat the number to show doubling. Then move onto pictorial representations.

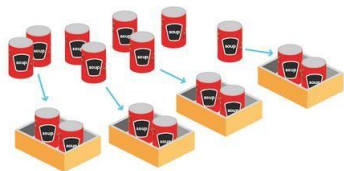


Division: Solve problems, including halving and sharing

Pupils should have many practical experiences of sharing objects e.g. sharing between 2 people, or finding $\frac{1}{2}$ of a group of objects.



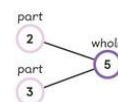
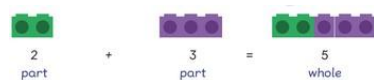
Use a range of concrete materials to show a number and then share them equally. Then move onto pictorial representations.



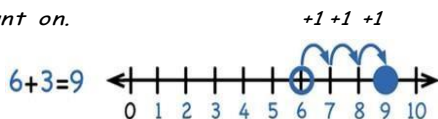
Year 1

Addition: Add one-digit and two-digit numbers to 20, including zero

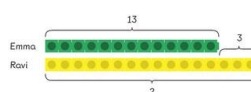
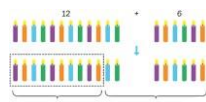
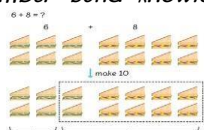
Use objects to count on and add by using number bonds.



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



Add by using number bond knowledge in order to make 10 / add the ones.



Introduce to the bar method. Use visual bars to show the calculation.

Subtraction: Subtract one-digit and two-digit numbers to 20, including zero

Building on from the EYFS methods, children consolidate understanding of subtraction practically. Use physical objects to count back, which is then reinforced on different number squares and number lines.

Subtract 3 from 15.



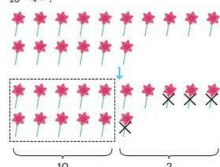
$$15 - 3 = 12$$



There are 12 flowers left.

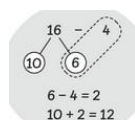
Pupils use knowledge of place value to partition 2 digit numbers in order to subtract ones from the number. They will be exposed to language such as "How much more" and "What is the difference between".

$$16 - 4 = ?$$

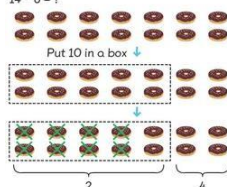


$$16 - 4 = 12$$

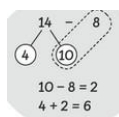
There are 12 flowers left.



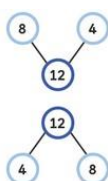
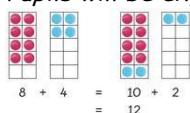
$$14 - 8 = ?$$



Sam has 6 doughnuts left.



Pupils will be exposed to the idea of commutativity to understand the idea of fact families.



$$\begin{aligned} 8 + 4 &= 12 \\ 4 + 8 &= 12 \end{aligned}$$

This is a family of addition and subtraction facts.

$$\begin{aligned} 12 - 8 &= 4 \\ 12 - 4 &= 8 \end{aligned}$$

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

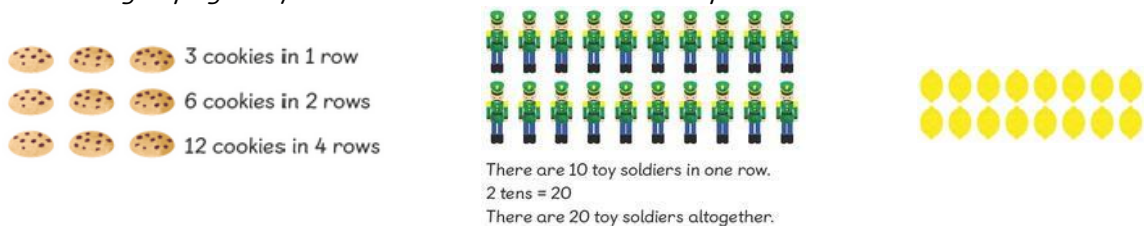
Year 1

Multiplication: Solve one-step problems involving multiplication by calculating the answer using concrete objects, pictorial representations and arrays

Children should practise making equal groups first and add them to associate repeated addition with multiplication. Use a range of concrete materials before pictorial representations.



Associate grouping to equal rows so children learn to count up in the same number.



Division: Solve one-step problems involving division by calculating the answer using concrete objects, pictorial representations and arrays

Building on multiplication knowledge and EYFS division strategies, children practise grouping concrete objects equally in order to count the amount in each group. Use a range of concrete materials before pictorial representations.



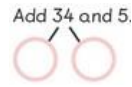
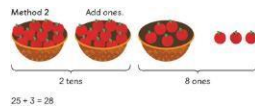
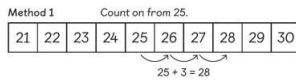
Build on practical materials by sharing and moving objects.



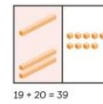
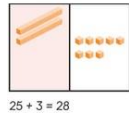
Year 2

Addition: Add with 2-digit numbers

Before moving onto the written method, children should add using a range of resources and methods.



Use a range of resources to add and associate to a written method (column method)

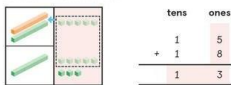


Use knowledge of number bonds to add numbers

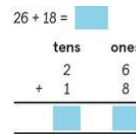


When renaming, show the expanded method, but link straight to the compact method.

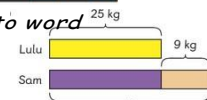
Step 1 Add the ones.
5 ones + 8 ones = 13 ones
Regroup the ones.
13 ones = 1 ten and 3 ones



Step 2 Add the tens.
1 ten + 1 ten + 1 ten = 3 tens

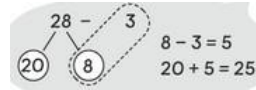
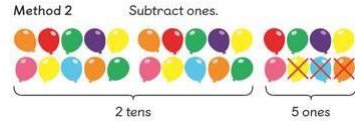
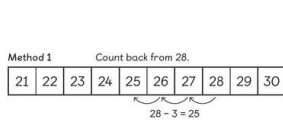


Children should use bars as a visual model to solve addition calculations and exposed to word problems.



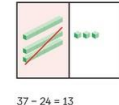
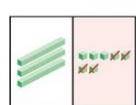
Subtract: Subtract with 2-digit numbers

Before moving onto the written method, children should add using a range of resources and methods, including using knowledge of number bonds to subtract numbers.

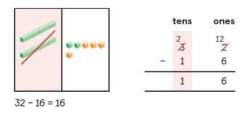


Use knowledge of subtraction to take away groups of 10. 4 - 1 = 30 therefore 40 - 10 = 30.

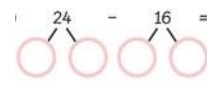
Use a range of resources to add and associate to a written method (column method)



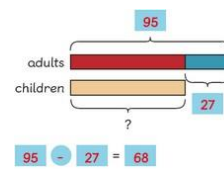
When renaming, you subtract the ones first, and then cross out the number you need to rename and write new number on top.



Use knowledge of number bonds to subtract.



Children should use bars as a visual model to solve subtraction calculations and exposed to word problems.



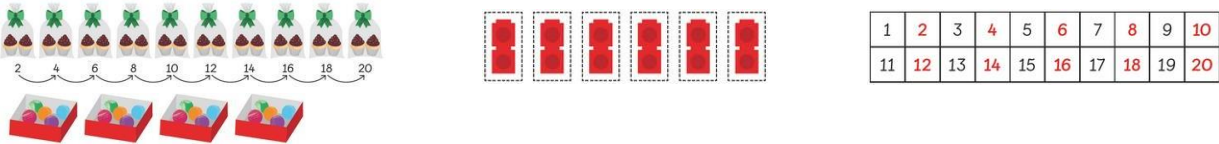
Year 2

Multiplication: Calculate mathematical statements and solve problems for multiplication within the multiplication tables (2, 5 & 10)

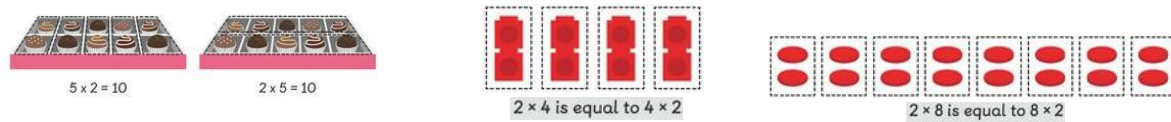
. Begin with consolidating Year 1 repeated addition and associate to multiplication.



Before moving onto the written method, children should add using a range of resources and methods



Children will associate the law of commutativity to multiplication using arrays and practical resources to show.



Move onto abstract route with problems.



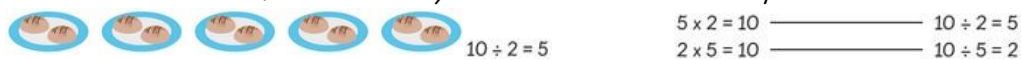
Division: Calculate mathematical statements and solve problems for division within the multiplication tables (2, 5 & 10)

Build on Year 1 by consolidating grouping equally. Use a range of resources to show division.

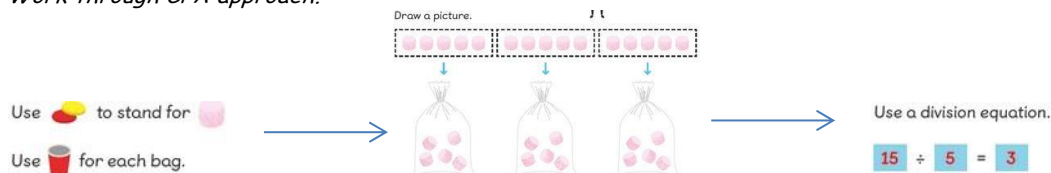
Work on each times table in order (2, 5 then 10). Use idea of grouping before show division and link to the abstract calculation with the ÷ sign.



Associate to the law of commutativity to show link between multiplication and division.



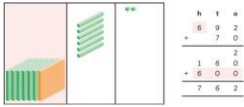
Work through CPA approach.



Year 3

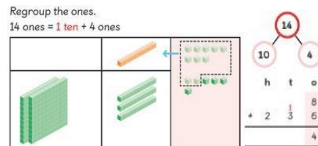
Addition: Add numbers with 3 digits

Introduce the expanded column method first using manipulatives first.



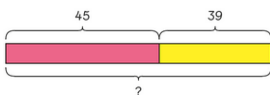
Add the ones first in preparation for the compact method.

Introduce addition with renaming using the compact method with manipulatives first. Show how to rename, with partitioning.



- Add the ones first.
- Carry the numbers directly above the next number, ensuring that the carried number is recorded first.
- The + symbol is positioned to the left, away from the digits

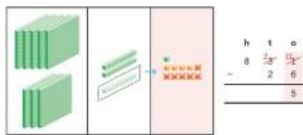
Continue to use bars as a visual model to solve addition calculations and exposed to word problems.



Subtraction: Subtract numbers with 3 digits

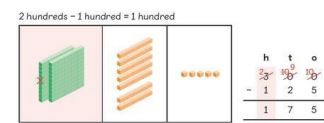
Children should use mental strategies to subtract 1 digit numbers and multiples of 10 from 3 digit numbers.

Introduce subtraction with renaming using the compact method with manipulatives first. Show how to rename, with partitioning.

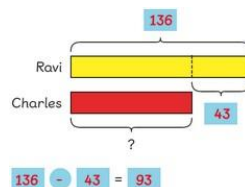


- Subtract the ones first.
- Cross out a number which needs renaming and write the new number directly on top.
- The - symbol is positioned to the left, away from the digits Carry on,

introducing multi-step renaming in single calculations.



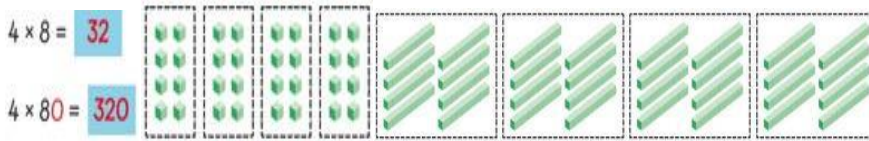
Continue to use bars as a visual model to solve subtraction calculations and exposed to word problems.



Year 3

Multiplication: Multiply 2-digits by a single digit number

Introduce by applying already known knowledge to multiples of 10. Use a range of manipulatives to show.

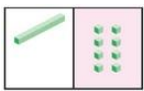


Consolidate repeated addition before moving onto multiplication of 2 digit numbers.

- Multiply the ones digit by the single-digit number
- Multiply the tens digit by the single-digit number

Show partition to show how this looks, using manipulatives as a supporting mechanism. Show column method alongside.

Multiply 12 by 4.



Step 1 Multiply the ones by 4.

2 ones \times 4 = 8 ones



Step 2 Multiply the tens by 4.

1 ten \times 4 = 4 tens

$$\begin{array}{r} 12 \times 4 = 48 \\ 10 \times 4 \quad 2 \times 4 \end{array}$$

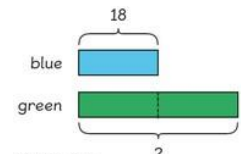
Show expanded method for conceptual understanding, but move straight onto the compact method using same techniques and break-downs.

When regrouping, always start with the larger value and write on top of the next digit.

$$\begin{array}{r} \text{2 tens} \quad \text{t} \quad \text{o} \\ \quad \quad 2 \quad 7 \\ \times \quad \quad 4 \quad 4 \\ \hline \quad \quad 8 \quad 8 \\ \hline \end{array}$$

8 ones

$$\begin{array}{r} \text{h} \quad \text{t} \quad \text{o} \\ \quad \quad 2 \quad 7 \\ \times \quad \quad 4 \quad 4 \\ \hline \quad 1 \quad 8 \quad 8 \\ \hline \end{array}$$



$$18 \times 2 = 36$$

There are 36 green crayons.

Continue to use CPA approach and visual bars when solving multiplication and division in word problems.

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

Introduce division by using manipulatives to divide (working on times table in order (2, 5, 10, 3, 4, 8). Show partitioning to link in division.

Show 'chunking' method of division, using known division facts take away chunks. Also show 'short division' method and link in methods together.

$$\begin{array}{r} 1 \quad 2 \\ 8 \overline{) 96} \\ \underline{- 80} \quad \\ 16 \\ \underline{- 16} \quad \\ 0 \end{array}$$

68 \div 2 = 34

Step 1 Divide 6 tens by 2.

6 tens \div 2 = 3 tens

Step 2 Divide 8 ones by 2.

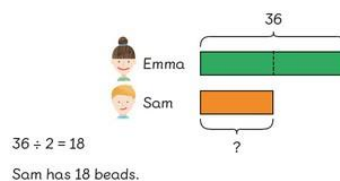
8 ones \div 2 = 4 ones

Step 3 Add the results.

6 tens \div 2 = 3 tens

8 ones \div 2 = 4 ones

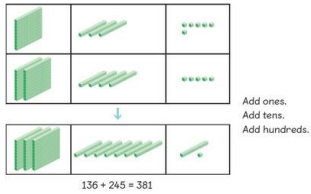
Continue to use CPA approach and visual bars when solving multiplication and division in word problems.



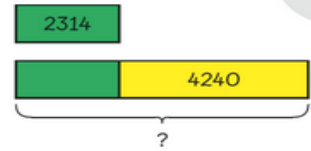
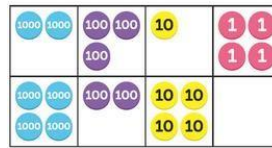
Years 4

Addition: Add numbers with 4 digits

Reinforce column method by using concrete materials first



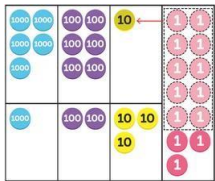
Find the sum of 2314 and 4240.



Move onto pictorial, using bar modelling.

Show expanded method to make link of place value. Move straight onto compact method. When renaming, the number is carried directly above the number.

Use concrete materials to show renaming.



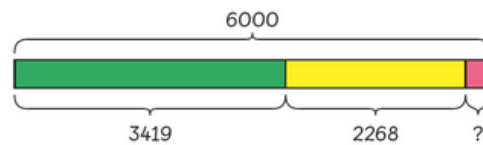
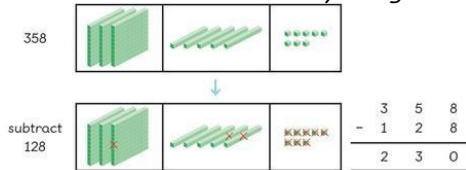
$$\begin{array}{r}
 4 \ 2 \ 5 \ 6 \\
 + 1 \ 9 \ 8 \ 7 \\
 \hline
 1 \ 3 \\
 1 \ 3 \ 0 \\
 + 5 \ 0 \ 0 \ 0 \\
 \hline
 6 \ 2 \ 4 \ 3
 \end{array}$$

add ones
add tens
add hundreds
add thousands

$$\begin{array}{r}
 1 \ 1 \ 1 \\
 4 \ 2 \ 5 \ 6 \\
 + 1 \ 9 \ 8 \ 7 \\
 \hline
 6 \ 2 \ 4 \ 3
 \end{array}$$

Subtraction: Subtract numbers with 4 digits

Reinforce column method by using concrete materials first, including for renaming.



Move onto pictorial, using bar modelling.

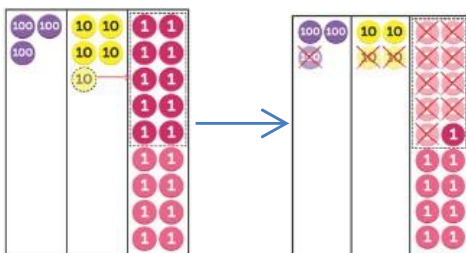
Show expanded method to make link of place value. Move straight onto compact method.

$$\begin{array}{r}
 5280 \\
 \begin{array}{l}
 5 \text{ thousands} \\
 - 3 \text{ thousands} \\
 \hline
 2 \text{ thousands}
 \end{array}
 \begin{array}{l}
 2 \text{ hundreds} \\
 - 1 \text{ hundred} \\
 \hline
 1 \text{ hundred}
 \end{array}
 \begin{array}{l}
 7 \text{ tens} \\
 - 6 \text{ tens} \\
 \hline
 1 \text{ ten}
 \end{array}
 \begin{array}{l}
 10 \text{ ones} \\
 - 9 \text{ ones} \\
 \hline
 1 \text{ one}
 \end{array}
 \end{array}$$

$$5280 - 3169 = 2111$$

When renaming, the number is crossed out and rewritten directly above.

Use concrete materials to show renaming.



$$\begin{array}{r}
 3 \ 4 \ 18 \\
 - 1 \ 2 \ 9 \\
 \hline
 2 \ 2 \ 9
 \end{array}$$

Years 4

Multiplication: Multiply 2 and 3-digit numbers by a single digit, using all multiplication tables up to 12×12

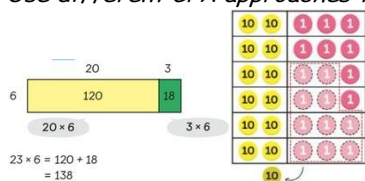
Pupils should continue to develop their knowledge and understanding of multiplying by a single digit, using short multiplication (the formal written method of compact multiplication).

Show expanded method but move straight onto compact method, as in Year 3, to show why and how to regroup.

$$\begin{array}{r}
 \\
 \times \quad \overset{\textcolor{red}{1}}{2} \quad \overset{\textcolor{blue}{3}}{6} \\
 \hline
 \textcolor{red}{1} \quad \textcolor{red}{3} \quad 8 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 \\
 \times \qquad \quad 2 \quad 3 \\
 \hline
 + \quad \textcolor{red}{1} \quad \textcolor{red}{2} \quad \textcolor{red}{0} \\
 \hline
 \textcolor{red}{1} \quad \textcolor{red}{3} \quad 8
 \end{array}$$

Use different CPA approaches to show the same calculation.



Pupils must be secure in multiplying a 2-digit number by a single digit, before moving onto 3-digit numbers. Repeat using same process as 2-digit numbers.

$$\begin{array}{r}
 1 \\
 \times \quad 4 \quad 7 \quad 3 \\
 \hline
 9 \quad 4 \quad 6
 \end{array}$$

$$\begin{array}{r}
 4 \quad 7 \quad 3 \\
 \times \quad 2 \\
 \hline
 6 \\
 1 \quad 4 \quad 0 \\
 + \quad 8 \quad 4 \quad 0 \\
 \hline
 9 \quad 4 \quad 6
 \end{array}$$

$$\begin{array}{r}
 400 \times 2 = 800 \\
 70 \times 2 = 140 \\
 3 \times 2 = 6 \\
 \hline
 473 \times 2 = 946
 \end{array}$$

Division: Divide up to 3-digit numbers by a single digit

Pupils should continue to develop their knowledge and understanding of dividing by two-digits, using chunking and short division. Move onto 3-digit using same approach.

$$\begin{array}{r} 102 \\ 4 \overline{) 408} \\ \underline{- 4} \\ 8 \\ \underline{- 8} \\ 0 \end{array}$$

If there is a remainder, this should be noted after the quotient.

$$\begin{array}{r} \overset{1}{7} \overset{2}{5} \\ 6 \overline{) 75} \\ \underline{- 6} \\ 15 \\ \underline{- 12} \\ 3 \end{array}$$

$75 \div 6 = 12$ remainder 3
quotient

Move onto 3-digit numbers divided by a single digit number after children are secure with 2-digit numbers. Use same concept; show chunking and short division, with CPA approach.

The diagram illustrates three methods for dividing 100 by 3:

- Long Division:**

$$\begin{array}{r} 3 \overline{) 100} \\ \underline{- 90} \\ 10 \\ \underline{- 9} \\ 1 \end{array}$$

Annotations: 90 is 3 tens; 9 is 3 ones; 1 is the remainder.
- Place Value Blocks:**

100 is represented by 10 tens rods. These are traded into 9 tens rods and 10 ones units. The 9 tens rods are grouped into 3 groups of 3 tens rods each. The 10 ones units are grouped into 3 groups of 3 ones units each, with 1 one unit left over. The result is 33 with a remainder of 1.
- Tree Diagram:**

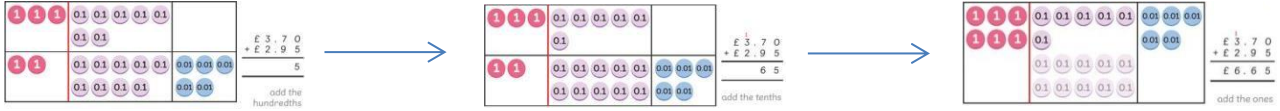
A tree diagram showing the division process: 100 is divided into 90 and 10. 90 is divided into 30 and 30. 30 is divided into 9 and 21. 21 is divided into 9 and 12. 12 is divided into 9 and 3. 3 is the remainder.

Years 5 - 6

Addition: Add numbers with more than 4 digits

Carry on using previous methods taught in previous years to add, using the same terminology. Continue up to place value being taught.

When adding decimals, use place value counters to show addition and use when renaming.

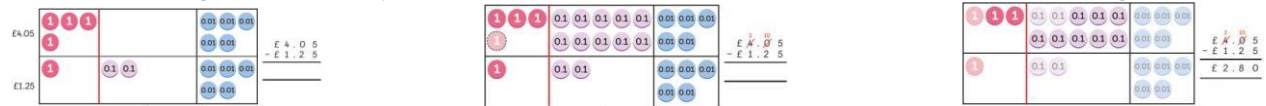


Subtraction: Subtract numbers with more than 4 digits

Carry on using previous methods taught in previous years to subtract, using the same terminology.

Continue up to place value being taught.

When subtracting decimals, use place value counters to show subtraction and use when renaming.



Years 5 - 6

Multiplication: Multiply numbers up to / more than 4 digits (with decimals in Yr6)

Carry on using previous methods taught in previous years to multiply, using the same terminology. Continue up to place value being taught. Start with 4 digits multiply by 1 digit before slowly adding further digit.

$$\begin{array}{r}
 \overset{1}{\underset{4}{28}} \\
 \times 26 \\
 \hline
 168 \rightarrow 28 \times 6 \\
 + 56 \rightarrow 28 \times 20 \\
 \hline
 728
 \end{array}$$

When multiplying decimals, use same method but ensure decimal point is in with all values carefully written, in line, on either side.

Division: Divide at least 4 digits by single-digit numbers (and 2-digit numbers in Yr 6)

Carry on using previous methods taught in previous years to divide, using the same terminology. Continue up to place value being taught. Start with 4 digits divide by 1 digit before slowly adding further digit.

Show long and short division method. When using long and short division fact boxes can be used to help when

$$5048 \div 8 = 631$$

$$\begin{array}{r}
 0631 \\
 8 \overline{) 5048} \\
 \underline{- 4800} \\
 248 \\
 \underline{- 240} \\
 8 \\
 \underline{- 8} \\
 0
 \end{array}$$

subtracting.

With remainders, continue with same method but replace new value with a crossing out. Put remainders as decimals and fractions. In year 6, show how to continue with 0s after the decimal point.

$$376 \text{ ml} \div 5 = 75 \frac{1}{5} \text{ ml}$$

$$\begin{array}{r}
 5 \overline{) 376} \\
 \underline{- 350} \rightarrow 70 \\
 26 \\
 \underline{- 25} \rightarrow 5 \\
 1 \rightarrow \frac{1}{5}
 \end{array}$$

Dividing by 2 digit numbers

Use same strategies to long division above but with the use of a fact box to aid calculations. Example is shown in the box opposite.

Dividing by 2 digit numbers