THAKEHAM PRIMARY SCHOOL

'Small School, Big Opportunities, Great Achievements'

STARS Maths Calculations Policy

Thakeham Primary School

Date approved by Standards, Teaching & Learning Committee: 01.09.17

Review Date: April 2019

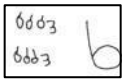
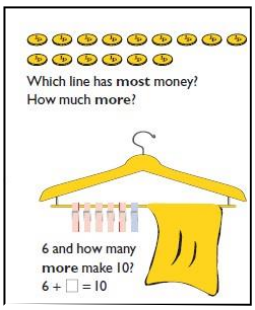
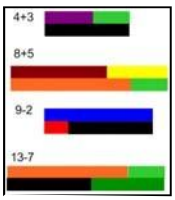
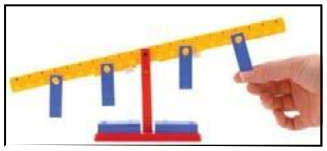
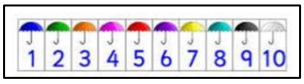
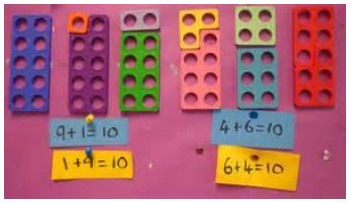
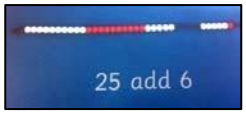
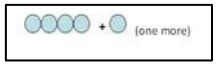
Signed

Headteacher: S. Norton

Chair of Governors:

Addition

STARS schools Calculation Policy for Addition: Year 1

Mental Calculations	**Read, write and interpret mathematical statements using symbols +, - , =** **Represent and use number bonds and related addition facts within 20** **Add one digit and two digit numbers up to 20, including zero.** **Solve one step problems using concrete objects and pictorial representations, and missing number problems.** **Given a number, identify (and use the language) one more**
Written Calculations	Begin to compare (what's the same/different?) for commutative sums e.g 3 +7 = 7 + 3 *Memorise and reason with number bonds to 10 & 20 in several forms* Add using objects, Numicon, cubes etc and number lines and tracks Check with everyday objects Ensure pre-calculation steps are understood, including: Counting objects (including solving simple concrete problems) Conservation of number: Recognise place value in numbers beyond 20 Counting as reciting and as enumerating   1 2 3 
Representations to support mental and written calculations.	Use a range of concrete and pictorial representations, including:      Number lines   Bead strings  Number tracks Real everyday objects  

STARS schools Calculation Policy for Addition: Year 2

Mental Calculations

Add numbers using concrete objects, pictorial representations, and mentally, including:

- **a two digit number and ones**
- **a two digit number and tens**
- **two two digit numbers**
- **adding three one digit numbers**

17 + 2 = 19 12 + 4 = 16
57 + 2 = 59 32 + 34 = 66

Recall and use addition addition and subtraction facts to 20 facts fluently, and derive and use related facts up to 100

Demonstrate the commutative law of addition

12 + 30 = 30 + 12
□ + 25 = 25 + 41

65 = 60 + 5
65 = 50 + 15
65 = 40 + 25
65 = 30 + 35
65 = 20 + 45
65 = 10 + 55

Written Calculations

Re-partition numbers eg.

- Use a hundred square
- *Check calculations using inverse and by adding numbers in different order*

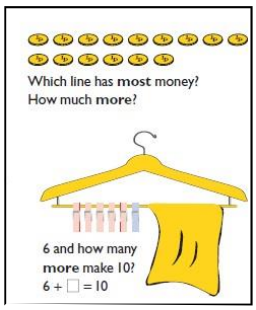
Begin to *record addition in columns to support place value and prepare for formal written methods with larger numbers*

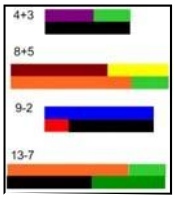
30 + 4
20 + 5
50 + 9

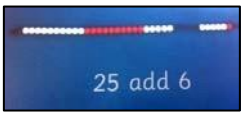
40 + 3
20 + 6
60 + 9

Representations to support mental and written calculations.

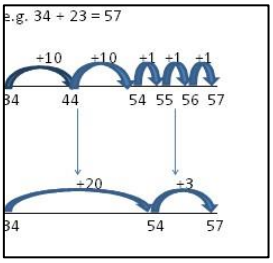
Use a range of concrete and pictorial representations, including:



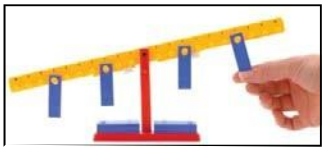


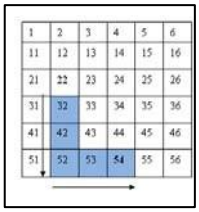


Bead strings



Number lines



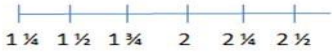


Number tracks

Real everyday objects

Fractions

Counting in fractions up to 10, starting from any numbers and using the 1/2 and 2/4 equivalence on the number line



STARS schools Calculation Policy for Addition: Year 3

Mental Calculations

Add numbers mentally, including:

- **a three digit number and ones**
- **a three digit number and tens**
- **a three digit number and hundreds**

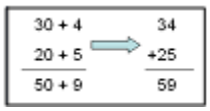
Partition all numbers and recombine, start with
TU + TU then HTU + TU
Use straws, dienes, place value counters, empty number lines

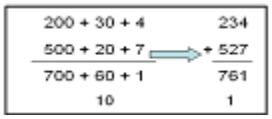
Common mental calculation strategies:
Partitioning and recombining
Doubles and near doubles
Use number pairs to 10 and 100
Adding near multiples of ten and adjusting
Using patterns of similar calculations
Using known number facts
Bridging though ten, hundred
Complementary addition

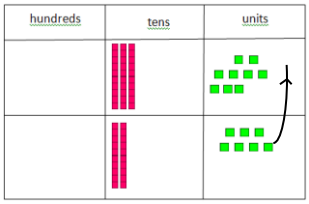
Written Calculations

Add numbers with up to three digits, using formal written (columnar) methods

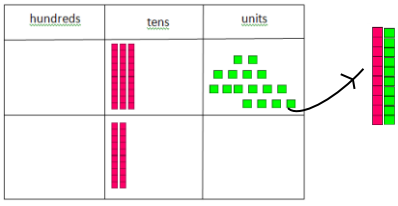
Add to three digit numbers using physical and abstract representations (e.g. straws, dienes, place value counters, empty number lines).







39
+
27



Revert to concrete representations if children find expanded/column

39
+ 27
6
1

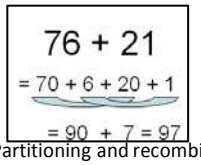
39
+ 27
66
1

Representations to support mental and written calculations.

Use a range of concrete, pictorial and abstract representations, including those below

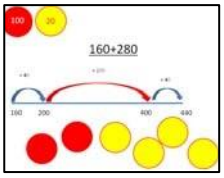
Bundles of straws

42 + 31 = 73



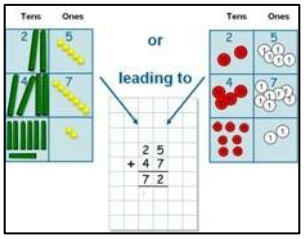
Partitioning and recombining

0 + 50 + 3
10 + 40 + 3
20 + 30 + 3
30 + 20 + 3
40 + 10 + 3
50 + 0 + 3



What is the same and what is different about all these methods?

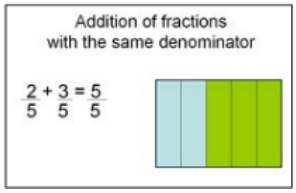
I can explain my method using representations



Dienes and place value counters

Fractions

Addition of fractions with the same denominator within one whole.

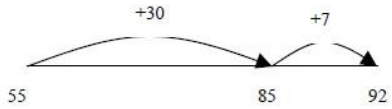


STARS schools Calculation Policy for Addition: Year 4

Informal methods to support mental Calculations

Practise mental methods with increasingly large numbers

Consolidate partitioning and re-partitioning
Use compensation for adding too much/little and adjusting
Use straws, Dienes, place value counters,
empty number lines etc.



I know that 63 + 29 is the same as 63 + 30 –1

55 + 37 = 55 + 30 + 7
= 85 + 7
= 92

Common mental calculation strategies:
Partitioning and recombining
Doubles and near doubles
Use number pairs to 10 and 100
Adding near multiples of ten and adjusting
Using patterns of similar calculations
Using known number facts
Bridging though ten, hundred
Complementary addition

Written Calculations

Add numbers with up to four digits, using the formal written (columnar) method (with inverses)

Add three digit numbers using columnar method and then move onto 4 digits.
Include decimal addition for money.

789 + 642 becomes

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

Answer: 1431

£75.28
£16.32
£ .

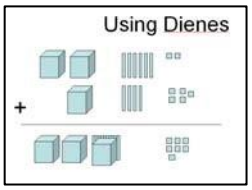
Revert to expanded methods if children find formal calculation method difficult

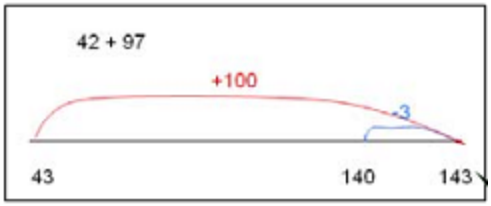
Representations to support mental and written calculations.

Use physical/pictorial representations alongside expanded and columnar methods.

Bundles of straws

42 + 31 = 73





Compensating in mental addition

£12.32
+ £11.81
£24.13
1

0 + 50 + 3
10 + 40 + 3
20 + 30 + 3
30 + 20 + 3
40 + 10 + 3
50 + 0 + 3

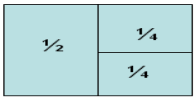
Re-partitioning

Place value cards & counters to counters, support the expanded method in readiness for the column

Fractions

Addition of fractions with the same denominator *to become fluent through a variety of increasingly complex problems beyond one whole Counting using simple fractions and decimals, both forwards and backwards*

$$\frac{1}{2} + \frac{2}{4} = \frac{2}{4} + \frac{2}{4} = 1$$



STARS Schools Calculation Policy for addition: Year 5

Informal methods to support mental Calculations

Add numbers mentally with increasingly large numbers, e.g. 12 462 + 2300 = 14 762
Mentally add tenths, and one digit numbers and tenths
Add decimals, including a mix of whole numbers and decimals, decimals with different numbers of places, and complements of 1 (e.g. 0.83 + 0.17 = 1)

- Children use representation of choice
- Refer back to pictorial and physical representations when needed

Common mental calculation strategies:
Partitioning and recombining
Doubles and near doubles
Use number pairs to 10 and 100
Adding near multiples of ten and adjusting
Using patterns of similar calculations
Using known number facts
Bridging though ten, hundred, tenth
Complementary addition

Written Calculations

Add whole numbers with more than four digits, using the formal written (columnar) method
Add three digit numbers using columnar method and then move onto 4 digits.
Include decimal addition for money

789 + 642 becomes

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

Answer: 1431

```
  24172m
+  5929m
--------
  30101m
 1 1 1 1
```

```
  £563.14
+ £207.88
--------
  £771.02
  1 1 1
```

Revert to expanded methods if children find formal calculation method difficult (see Y3)

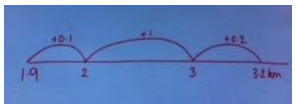
Representations to support mental and written calculations.

Use physical/pictorial representations alongside columnar methods where needed.

12 462 + 2300
= 12 462 + 2000 + 300
= 14 462 + 300
= 14 762

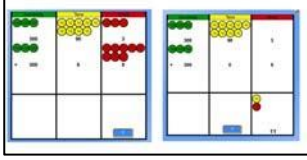
Partitioning and recombining

Ask **what is the same** and **what is different** about all these methods?



Jottings to support mental calculation

Place Value counters to support column addition

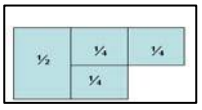


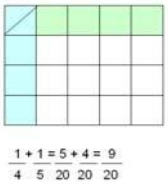
```
  393
+ 308
-----
  1
  1
```

Fractions

Add fractions with the same denominator and denominators that are multiples of the same number *(to become fluent through a variety of increasingly complex problems and add fractions that exceed 1 as a mixed number)*

$$\frac{1}{2} + \frac{3}{4} = \frac{2}{4} + \frac{3}{4} = \frac{5}{4}$$





$$\frac{1}{4} + \frac{1}{5} = \frac{5}{20} + \frac{4}{20} = \frac{9}{20}$$

STARS schools Calculation Policy for Addition: Year 6

Informal methods to support mental Calculations

Perform mental calculations, including with mixed operations and large numbers *(more complex calculations)*

- Children use representation of choice
- Consolidate partitioning and re-partitioning
- Use compensation for adding too much/little and adjusting
- Refer back to pictorial and physical representations when needed.

Common mental calculation strategies:
Partitioning and recombining
Doubles and near doubles
Use number pairs to 10 and 100
Adding near multiples of ten and adjusting
Using patterns of similar calculations
Using known number facts
Bridging though ten, hundred, tenth
Complementary addition

Written Calculations

Add larger numbers using the formal written (columnar) method including and exceeding 4 digits. Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why.

- Add three digit numbers using columnar method and then move onto and exceed 4 digits. Include decimal addition for money

£563.14
+ £207.88
£771.02
1 1 1

17259.74
+ 6734.89

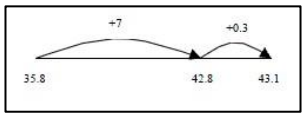
Revert to expanded methods if children find formal calculation method difficult (see Y3)

Representations to support mental and written

Use physical/pictorial representations alongside columnar methods where needed. Ask what is the same and what is different?

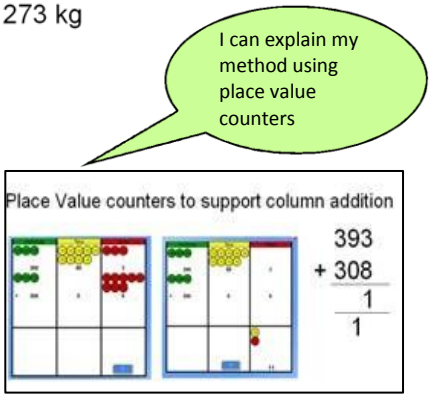
12 462 + 2300
= 12 462 + 2000 + 300
= 14 462 + 300
= 14 762

Partitioning and recombining



234 kg + 49 kg = 273 kg

200 + 30 + 4
40 + 9
200 + 70 + 13



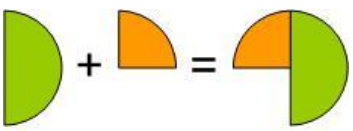
Fractions

Add fractions with different denominators and mixed numbers, using the concept of equivalent fractions

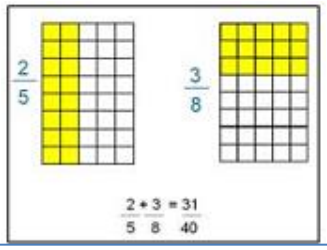
- Start with fractions where the denominator of one fraction is a multiple of the other (e.g. 1/2 + 1/8 = 5/8)

and progress to varied and increasingly complex problems

- Practise calculations with simple fractions and decimal equivalents to aid fluency



$$\frac{1}{2} + \frac{1}{4} = \frac{3}{4}$$

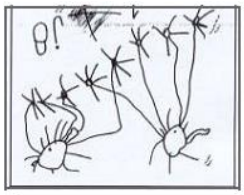


Division

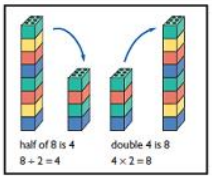
STARS schools Calculation Policy for Division: Year 1

Mental Calculations

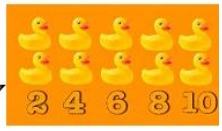
Solve one-step problems involving multiplication and division, by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher. ***(Pupils) make connections between arrays, number patterns, and counting in twos, fives and tens.*** **Count on or back in 2s, 5s and 10s and look for patterns.**



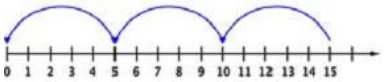
Pictorial jottings to support the calculation of 8 ÷ 4



Songs are useful for counting in steps.



Children should experiment with the concepts of sharing and grouping in a number of contexts. Initially they use their own recording—moving towards fluent, symbolic notation in Year 2. Conceptual understanding and recording should be continuously supported by the use of **arrays** as a default model, as well as other representations, (see below.)



The relationship between multiplication and division must be continually considered.

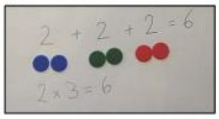
Written Calculations

Representations to support mental and written calculations.

Use a range of concrete and pictorial representations, including:

- Manipulatives to support children's own recording; and understanding of *sharing* and the link with multiplication.
  "How can we share 6 cakes between 2 people?"

Here, the cakes are placed in an array formation.



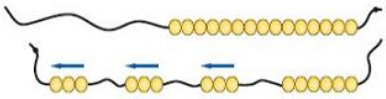
How many 2 tiles can we fit on the 6 tile?

Moving from concrete to pictorial, counters represent the cakes to reinforce the relationship between multiplication and division.

- Manipulatives, and real-life objects to support children's own recording; and understanding of *grouping* and the link with multiplication.

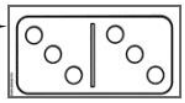
Coat hangers and socks support calculation of 8÷2

Bead strings



15 ÷ 2 using grouping model

"Double 3 is 6. Half of 6 is 3."



- Dominoes and dice to reinforce concepts of doubling and halving.

Fractions

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. (*See* Representations *above.)*

STARS schools Calculation Policy for Division: Year 2

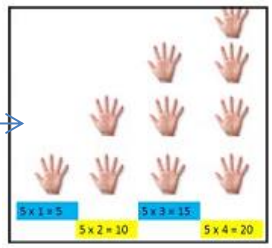
Mental Calculations

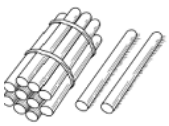
- **Recall and use multiplication and division facts for the 2, 5 and 10 times tables, including recognizing odd and even numbers**
- **Calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication, division and equals signs**
- **Show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot.**
- **Solve problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, multiplication and division facts, including problems in contexts.**

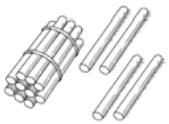
Written Calculations

The relationship between multiplication and division must be continually considered.

"5, one time", "5, two times" and so on.







½ of 26 = 13
26 ÷ 2 = 13

Pupils decode a problem first, represent it using manipulatives and jottings; and finally record it symbolically.

Representations to support mental and written calculations.

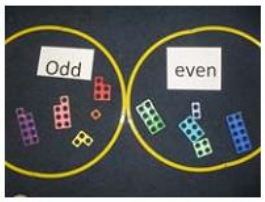
Use a range of concrete and pictorial representations, including:

- Arrays

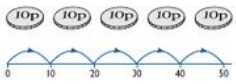
7 x 2 = 14
14 ÷ 2 = 7

2 x 7 = 14
14 ÷ 7 = 2

Is 14 an odd number? How do you know?

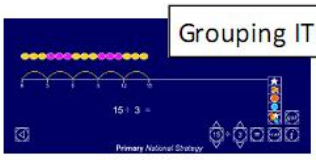


- Number lines to support grouping



10p + 10p + 10p + 10p + 10p = 50p
10p × 5 = 50p
5 hops of 10

Grouping ITP



"How many groups of 5 minutes have passed when the minute hand reaches twenty past?"

- Representations to support multiplicative reasoning:

Using Dienes: "If 40 ÷ 10 = 4 and 30 ÷ 10 = 3, what do you think 70 ÷ 10 would be? Why?"

Fractions

Recognise, find, name and write fractions ⅓, ¼, ¾, 2/4 of a length, shape, set of objects or quantity
Write simple fractions for example, ½ of 6 = 3 and recognise the equivalence of ½ and 2/4.

STARS schools Calculation Policy for Division: Year 3

Mental Calculations

Pupils should be taught to recall and use multiplication and division facts for the 3, 4 and 8 multiplication tables.

Pupils continue to practise their mental recall of multiplication tables... in order to improve fluency.

Pupils develop efficient mental methods, for example, using commutativity and associativity (e.g., 4 × 12 × 5 = 4 × 5 × 12 = 20 × 12 = 240) and multiplication and division facts to derive related facts.

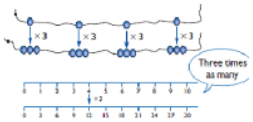
36 ÷3 = 12

30 6

30 ÷3=10 6 ÷3=2

\+

"4 x 3 is 12, so 12 ÷ 3 = 4."



Written Calculations

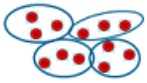
Pupils should be taught to:

- Write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two digit numbers times one digit numbers, using mental and progressing to formal written methods.
- Solve problems, including missing number problems involving multiplication and division, including positive integer scaling problems.

New written methods can be modelled alongside mental or informal methods to ensure understanding.

"I know 6÷3=2, so 60÷3=20."
"I know 12÷3=4, so 120÷3=40."

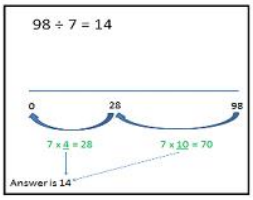
120 ÷ 3



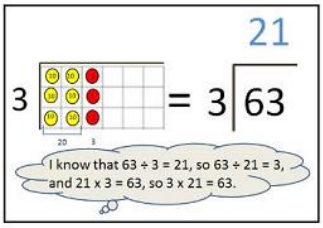
40
3 | 120

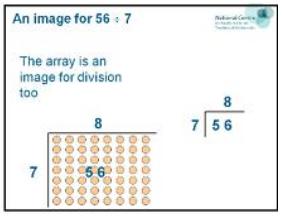
Representations to support mental and written calculations.

Use a range of concrete and pictorial resources, including:



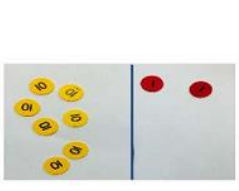
63 ÷ 3 equals three groups of 2 tens and a one.

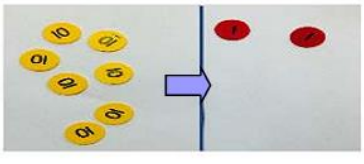


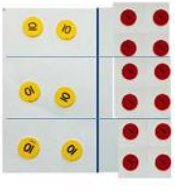


How could I calculate 72÷3 ?

Informal exploration with manipulatives supports the progression to formal written methods—which is continued in Year 4.



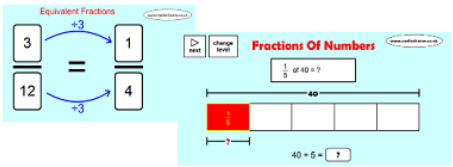




24
3 | 72

Fractions

- **Recognise that tenths arise from dividing an object into 10 equal parts and in dividing one-digit numbers or quantities by 10.**
- **Recognise and show, using diagrams, equivalent fractions with small denominators.**
- **Recognise, find and write fractions of a discrete set of objects: unit fractions and non-unit fractions with small denominators.**



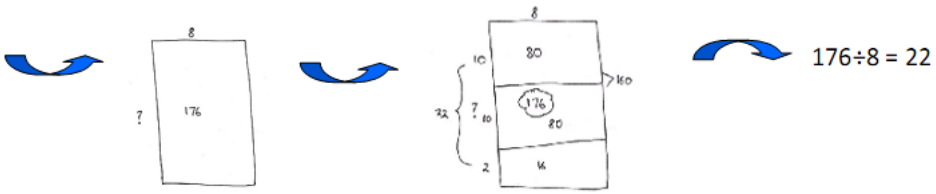
STARS schools Calculation Policy for Division: Year 4

Informal methods to support mental calculations

Pupils should be taught to:

- Recall multiplication and division facts for multiplication tables up to 12 x 12
- Use place value, known and derived facts to multiply and divide mentally, including: multiplying by 0 and 1; dividing by 1; multiplying together three numbers
- Recognize and use factor pairs and commutativity in mental calculations

Using known facts and blank arrays to calculate 176÷8.



Pupils practise mental methods and extend this to three-digit numbers to derive facts.

Written Calculations

Pupils should be taught to:

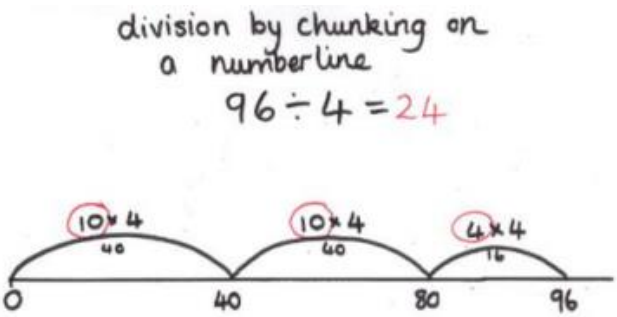
- **multiply two-digit and three-digit numbers by a one-digit number using formal written layout**
- **solve problems involving multiplying and adding, including using the distributive law to multiply two digit numbers by one digit, integer scaling problems and harder correspondence problems such as n objects are connected to m objects.**

Pupils practise to become fluent in the formal written method of short multiplication and short division with exact answers .

Revert to expanded methods if children find formal calculation method difficult

Representations to support mental and written calculations.

Revert to chunking on a number line for children finding the short division method difficult



Models f… ls for division

Using manipulatives to develo… levelop a conceptual understanding of the short v… ıort written method

1

135 ÷ 3

We can't make the 1 hundred we have. Exchange the 1 hundred for 10 tens.

$3\overline{)135}$

What's different about these models? What is the same?

2

We now have 13 tens

$3\overline{)1^{1}35}$

What's different about these models? What is the same?

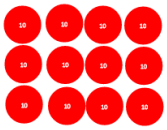
Representations to support mental and written calculations.

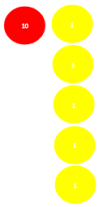
3

Models for division

g manipulatives to develop a conceptual understanding of the short written method

We can make 4 groups of three 10s, leaving one 10





$$3\overline{)13\ 5}\quad 4$$

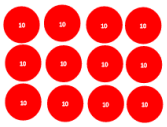
What's different about these models?
What is the same?

4

Models for division

Using manipulatives to develop a conceptual understanding of the short written method

We need to exchange the one 10 for ten 1s



$$3\overline{)13\ 5}\quad 4$$

What's different about all these models?
What is the same?

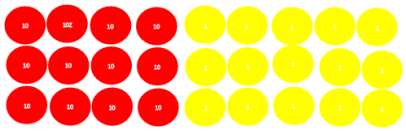
5

Models for division

Using manipulatives to develop a conceptual understanding of the short written method

We can make 5 groups of three 1s, giving an answer of 45

$$3\overline{)13\ 5}\quad 45$$

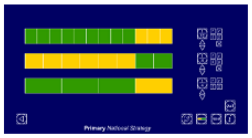


What's different about all these models?
What is the same?

Fractions

Pupils should be taught to:

- *recognise and show, using diagrams, families of common equivalent fractions*
- *recognise that hundredths arise when dividing an object by one hundred and dividing tenths by ten.*
- *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*
- *find the effect of dividing a one- or two-digit number by 10 and 100, identifying the value of the digits in the answer as ones, tenths and hundredths*



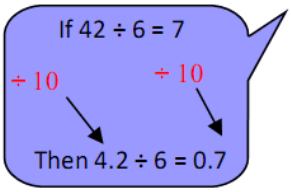
STARS schools Calculation Policy for Division: Year 5

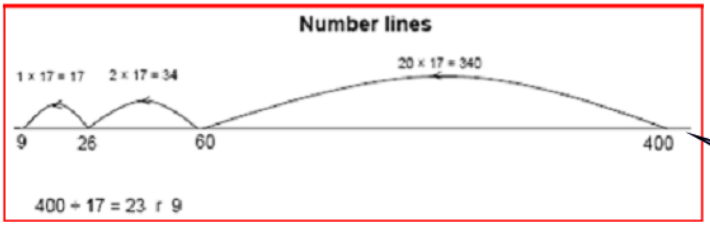
Informal methods to support mental calculations

. Pupils should be taught to:

- **multiply and divide whole numbers and those involving decimals by 10, 100 and 1000**
- **multiply and divide numbers mentally drawing upon known facts**

identify multiples and factors, including finding all factor pairs of a number, and common factors of two numbers .





Factorising
480 ÷ 15
= 480 ÷ 5 ÷ 3

"I know that the answer to 138 ÷ 6 will be close to 20, because 2 x 6 = 12, so 20 x 6 = 120."

Pupils apply all the multiplication tables and related division facts frequently and use them confidently .

Written Calculations

Pupils should be taught to:

- Divide numbers up to 4 digits by a one digit number using the formal written method of short division and interpret remainders appropriately.

98 ÷ 7 becomes

$$\begin{array}{r} 14 \\ 7\overline{)98} \\ {\scriptstyle 2} \end{array}$$

Answer: 14

432 ÷ 5 becomes

$$\begin{array}{r} 86\ r2 \\ 5\overline{)432} \\ {\scriptstyle 3} \end{array}$$

Answer: 86 remainder 2

496 ÷ 11 becomes

$$\begin{array}{r} 45\ r1 \\ 11\overline{)496} \\ {\scriptstyle 5} \end{array}$$

Answer: $45\frac{1}{11}$

142 ÷ 4 = 35·5 r2

$$4\overline{)140^{1}2^{2}0} \quad 035{\cdot}5$$

2/4 = 1/2 = 0.5

73 ÷ 5

$$\begin{array}{r|l} 5 & 73 \\ -50 & (10 \times 5) \\ \hline 23 & \\ -20 & (4 \times 5) \\ \hline 3 & \end{array}$$

10 + 4 = 14

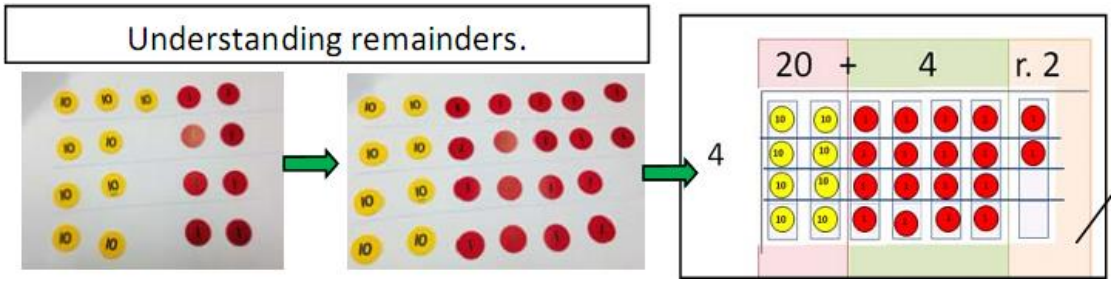
Downward chunking in preparation for the long division method (Year 6)

How many 5s have been subtracted?
14 sets of 5, with 3 left over.

Answer: 73 ÷ 5 = 14 r3

Representations to support mental and written calculations.

Introducing remainders: 98 divided by 4



= 98 ÷ 4 = $\frac{98}{4}$ = 24 r 2 = $24\frac{1}{2}$ = 24.5

What is the same? What's different about the ways that these remainders are expressed?

Fractions	• **Recognise mixed numbers and improper fractions and convert from one form to the other and write mathematical statements > 1 as a mixed number .** • ***Pupils connect equivalent fractions > 1 that simplify to integers with division and other fractions > 1 to division with remainders.*** • ***Pupils connect multiplication by a fraction to using fractions as operators (fractions of), and to division.*** • ***Pupils should make connections between percentages, fractions and decimals***

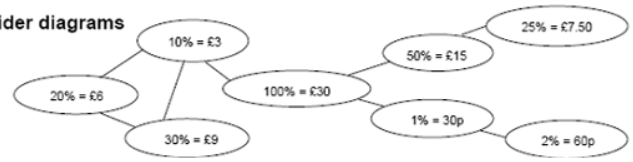
STARS schools Calculation Policy for Division: Year 6

Informal methods to support mental calculations

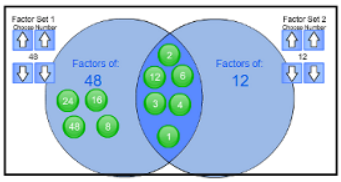
Pupils should be taught to:

- **perform mental calculations, including with mixed operations and large numbers.**
- **use their knowledge of the order of operations to carry out calculations involving the four operations.**
- **identify common factors, common multiples and prime numbers.**

Spider diagrams



I know that 366 will divide by 6 because it has 2 and 3 as factors



- **Solve problems involving addition, subtraction, multiplication and division**
- **use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.**

Written Calculations

Pupils should be taught to:

- Divide numbers up to four digits by a two digit whole number using the formal written method of long division, and interpret remainders, fractions, or by rounding as appropriate for the context.
- Divide numbers up to four digits by a two digit whole number using the formal written method of short division where appropriate, interpreting remainders according to the context.

Long division

432 ÷ 15 becomes

```
      2  8   r 12
   ------------
1 5 | 4  3  2
      3  0  0
   ------------
      1  3  2
      1  2  0
   ------------
         1  2
```

Answer: 28 remainder 12

432 ÷ 15 becomes

```
      2  8
   ------------
1 5 | 4  3  2
      3  0  0      15×20
   ------------
      1  3  2
      1  2  0      15×8
   ------------
         1  2
```

$\frac{12}{15} = \frac{4}{5}$

Answer: $28\frac{4}{5}$

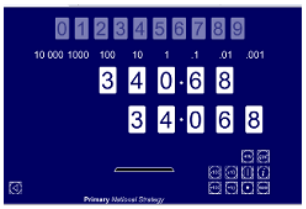
432 ÷ 15 becomes

```
      2  8 · 8
   ------------
1 5 | 4  3  2 · 0
      3  0   ↓
   ------------
      1  3  2
      1  2  0   ↓
   ------------
         1  2  0
         1  2  0
      ---------
               0
```

Answer: 28·8

Revert to expanded methods if children find formal calculation method difficult

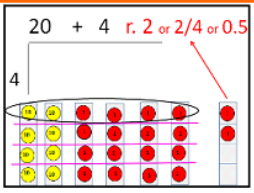
Representations to support mental and written calculations.



£1362.72 ÷ 40 = ?

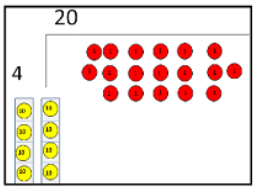
£1362.72 ÷ 4 = £340.68
[½ and ½ again.]
£340.68 ÷ 10 = £34.068
which rounds to £34.07.

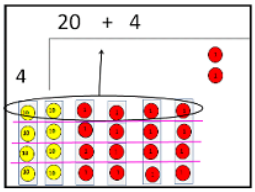
To introduce the long division model, use a calculation which can be represented both with manipulatives and by a short division algorithm. Use questioning and discussion to compare written methods.




```
      2  4  r.2
   ------------
4 |  9 ¹8
   - 8  0   (4 x 20 )
   ------------
      1  8
   -  1  6   (4 x 4 )
   ------------
         2
```

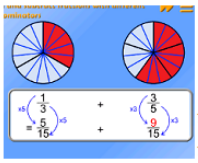
What's the same? What's different?

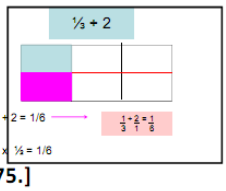




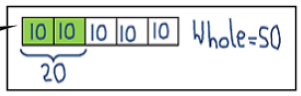
Fractions

- use common factors to simplify fractions,
- compare and order fractions, including fractions > 1
- add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions
- divide proper fractions by whole numbers [for example, 1/3 ÷2 = 1/6 .]
- associate a fraction with division and calculate decimal fraction equivalents [for example, 0.375.]
- *Pupils use their understanding of the relationship between unit fractions and division to work backwards.* use written division methods in cases where the answer has up to 2 dp.





2/5 of a number is 20.
What is the number?



Multiplication

STARS schools Calculation Policy for Multiplication: Year 1

Mental Calculations

- **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.**
- **Count in multiples of twos, fives and tens** with equipment, songs & rhythms, and including by rote
- Counting 2s e.g. counting socks, shoes, animal legs...
- Counting in 5 s e.g. counting fingers, fingers in gloves, toes …
- Counting in 10s e.g. counting fingers, toes …
- Doubles up to 10
- Recognising odd and even numbers
- Write as a number pattern (e.g. 5, 10, 15...; 2, 4, 6...; 10, 20, 30...)

Written Calculations

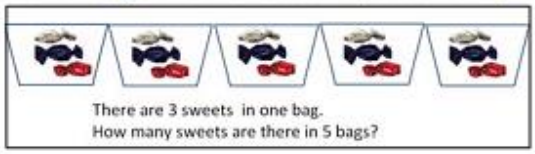
It is important to use a range of models to develop understanding of multiplication, and that children make connections between arrays, number patterns, and counting in twos, fives and tens

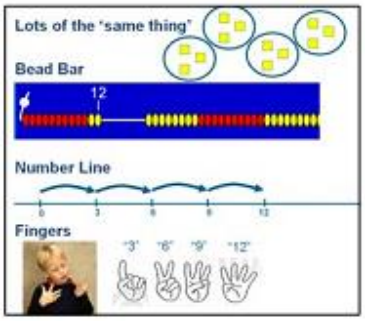
Although there is no statutory requirement for written multiplication in Year 1, it may be helpful to encourage children to begin to write it as a repeated addition sentence in preparation for Year 2

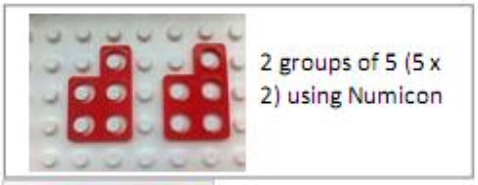
E.g. 2 + 2 + 2 + 2 = 8

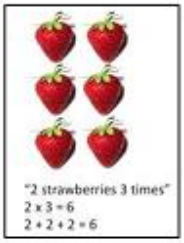
Representations to support mental and written calculations.

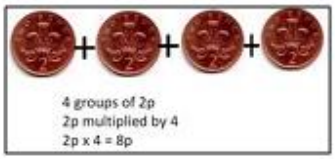
Use a range of concrete and pictorial representations, including:

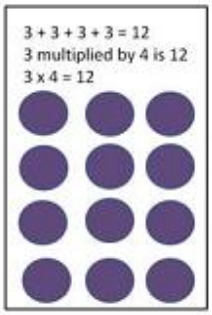


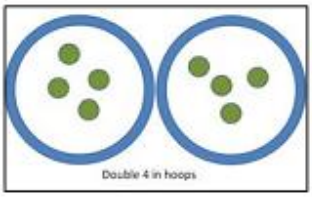


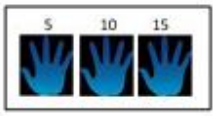








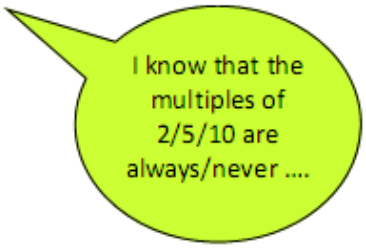




STARS schools Calculation Policy for Multiplication: Year 2

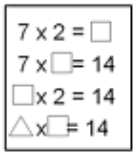
Mental Calculations

- **Recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables,** *connecting the 2, 5 and 10 multiplication tables to each other*
- *Connect the 10 multiplication table to place value*
- **Recognise odd and even numbers**
- **show that multiplication of two numbers can be done in any order (commutative)**
- *Use a variety of language to describe multiplication and division*
- Apply doubling of numbers up to ten to doubling larger numbers



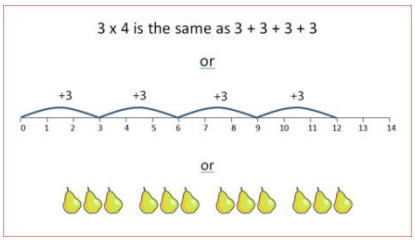
Written Calculations

- **calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (×), division (÷) and equals (=) signs**
- *Begin to use other multiplication tables and recall facts to perform written calculations*
- *Use a range of materials and contexts … including arrays and repeated addition*



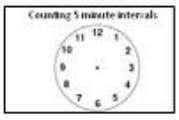
4 x 6 = 24

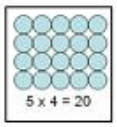
6 x 4 = 24

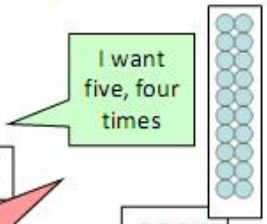


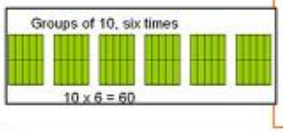
Representations to support mental and written calculations.

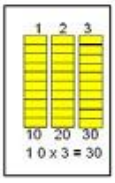
Use a range of concrete and pictorial representations, including:

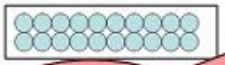


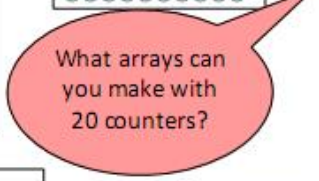


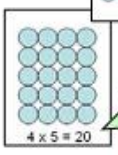


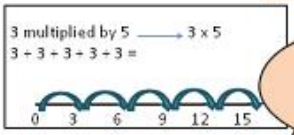


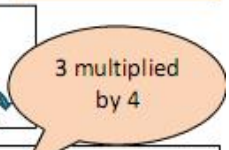


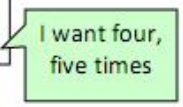


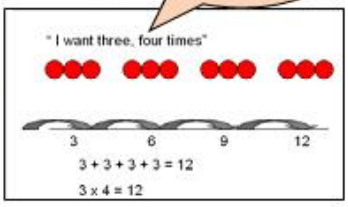


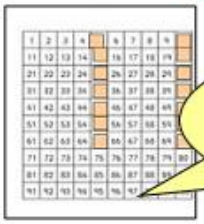


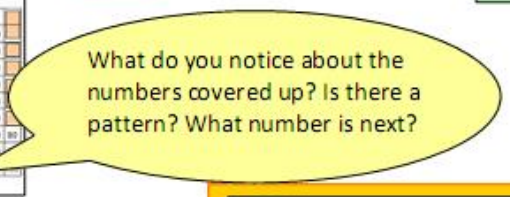


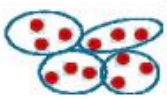


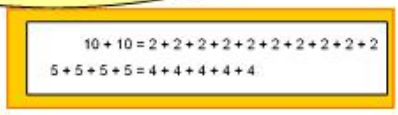


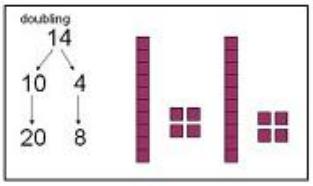












Fractions

x **write simple fractions for example, 1/2 of 6 = 3 and recognise the equivalence of 2/4 and 1 /2**

x *Begin to relate multiplication and division models to fractions and measures*

STARS schools Calculation Policy for Multiplication: Year3

Mental Calculations

- **Recall and use multiplication and division facts for the 3, 4 and 8 multiplication tables** (and 2, 5 and 10 multiplication tables from Y2)
- Use doubling to connect 2, 4 and 8 multiplication tables
- Develop efficient mental methods using commutativity and associativity
- Derive related multiplication and division facts
- **calculate mathematical statements for multiplication using the multiplication tables that they know, including for two digit numbers times one digit numbers, using mental methods**
- Partitioning: multiply the tens first and then multiply the units,

e.g. 57 x 6 = (50 x 6) + (7 x 6) = 300 + 42 = 342

- Children can apply these skills to solve spoken word problems too,
- Include missing number statements e.g $72 \div \square = 8$

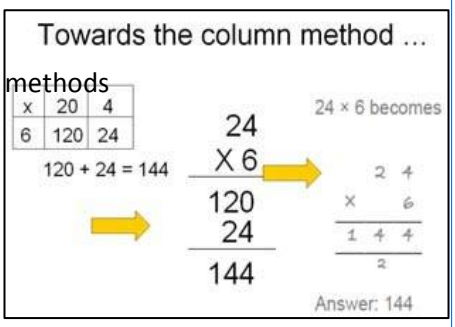
I have 12 packets, each containing 6 stickers. How many packets do I have in total?

Ensure opportunities to learn multiplication tables through use of visual models, images and also rote learning.

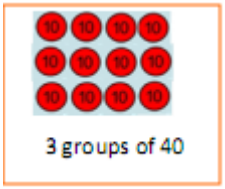
Multiplication and division facts:
8 x 4 = 32, 4 x 8 = 32, 32 ÷ 4 = 8, 32 ÷ 8 = 4

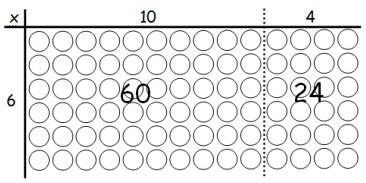
Written Calculations

- **Write and calculate mathematical statements for multiplication using the multiplication tables that they know, including for two digit numbers times one digit numbers, progressing to formal written methods**
- Estimate before calculating
- Ensure written methods build on/relate to mental methods

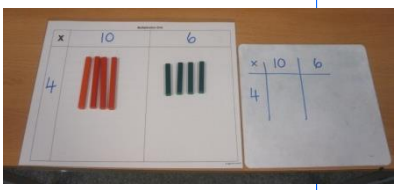


Representations to support mental and written calculations.





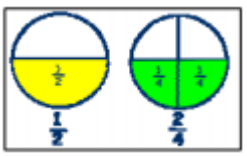
TU x U
16 x 4 =



Children's earlier use of arrays as a representation for multiplication leads on to the grid method as the first formal written method of multiplication. The use of practical resources runs alongside the written recording in the grid format.

Fractions

- recognise and show, using equivalent fractions with denominators



diagrams, small

STARS schools Calculation Policy for Multiplication: Year 4

Informal methods to support mental Calculations

- **recall multiplication and division facts for multiplication tables up to 12 × 12**
- **use place value, known and derived facts to multiply and divide mentally, including:**
- **multiplying by 0 and 1;**
- **dividing by 1;**
- **multiplying together three numbers**
- **recognise and use factor pairs and commutativity in mental calculations**
- practise mental methods and extend this to three digit numbers to derive facts, (for example 600 ÷ 3 = 200 can be derived from 2 x 3 = 6)

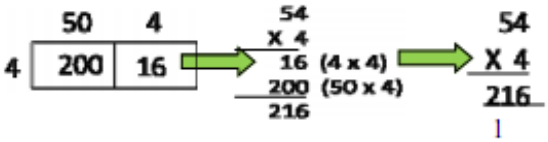
Using the **distributive** law:
39 x 7 = 30 x 7 + 9 x 7
Using the **associative** law:
(2 x 3) x 4 = 2 x (3 x 4)

Using facts and rules:
2 x 6 x 5 = 10 x 6 = 60

Written Calculations

Multiply two digit and three digit numbers by a one digit number using formal written layout

Estimate before calculating
Ensure written methods build on/relate to mental methods (e.g. grid method)
Introduce alongside grid and expanded column methods
Recap grid method, then expanded multiplication- moving onto short method.

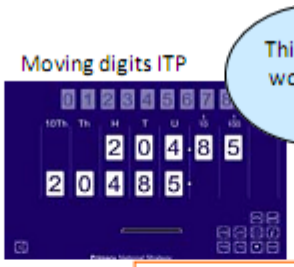


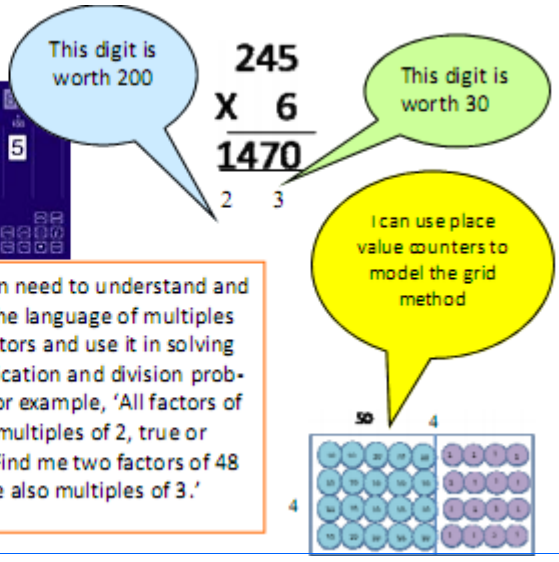
Revert to expanded methods if children find formal calculation method difficult

Key skills to support:
- know or quickly recall multiplication facts up to 12 × 12
- understand the effect of multiplying numbers by 10, 100 or 1000
- multiply multiples of 10, for example, 20 × 40;
- approximate, e.g. recognise that 72 × 38 is approximately 70 × 40 = 2800 and use this information to check whether their answer appears sensible

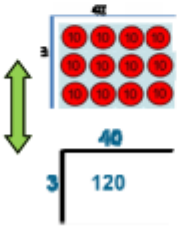
Representations to support mental

Ensure children can confidently multiply & divide by 10 and 100, that multiplying by 10 makes the number bigger and all digits move one place to the left, while dividing by 10 makes the number smaller and all the digits move one place to the right.





Use arrays made with place value counters to demonstrate the link between multiplication and division. This will support understanding of the grid method.



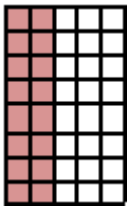
Children need to understand and apply the language of multiples and factors and use it in solving multiplication and division problems, for example, 'All factors of 36 are multiples of 2, true or false? Find me two factors of 48 that are also multiples of 3.'

Fractions

- **recognise and show, using diagrams, families of common equivalent fractions**
- understand the relation between non unit fractions and multiplication and division of quantities, with particular emphasis on tenths and hundredths.
- make connections between fractions of a length, of a shape and as a representation of one whole or set of quantities.
- use factors and multiples to recognise equivalent fractions
- and simplify where appropriate

$\frac{4}{10}\ \frac{6}{15}\ \frac{8}{20}\ \frac{10}{25}\ \frac{12}{30}\ \frac{14}{35}\ \frac{16}{40}$

$\frac{2}{5} = \frac{16}{40}$



STARS schools Calculation Policy for Multiplication: Year 5

Informal methods to support mental Calculations

- **Multiply and divide numbers mentally drawing upon known facts**
- **Multiply and divide whole numbers and those involving decimals by 10, 100 & 1000**
- **Recognise and use square & cube numbers (& notation)**

24 x 15 = ?

I did: 24 × 5 = 120 (half of 24 × 10), then multiplied 120 by 3 to get 360

I did: (24 × 10) + (24 × 5).

Example of constructing equivalence statements:
4 x 35 = 2 x 2 x 35;
3 x 270 = 3 x 3 x 9 x 10
= 92 x 10

Pupils should be taught throughout that percentages, decimals and fractions are different ways of expressing proportions.

Written Calculations

Multiply numbers up to 4 digits by a one or two digit number using a formal written method, including long multiplication for the two digit numbers.

When beginning with TU x TU

Expanded Method

The 4 *part products* are set out vertically underneath the calculation.

Part products totalled to give final product.

```
  46
 x 32
1200  (40 x 30)
 180  (6 x 30)
  80  (40 x 2)
  12  (6 x 2)
1472
```

Long Multiplication

24 × 16 becomes

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

Answer: 384

124 × 26 becomes

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

Answer: 3224

124 × 26 becomes

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

Answer: 3224

Does the answer seem sensible?

ThHTU x U Short Method

2741 × 6 becomes

```
   2 7 4 1
 ×       6
 1 6 4 4 6
   4 2
```

Answer: 16 446

Representations to support mental

3567 x 24

x	3000	500	60	7
20	60000	10000	1200	140
4	12000	2000	240	28

71340
14268
Total 85608

What is the same and what is different about these two methods?

```
 3567
 x24
14268
71340
85608
```

Fractions

- **multiply proper fractions and mixed numbers by whole numbers, supported by materials and diagrams**
- **identify, name and write equivalent fractions of a given fraction, represented visually, including tenths and hundredths**

Pupils connect multiplication by a fraction to using fractions as operators (fractions of), and to division, building on work from previous years. This relates to scaling by simple fractions, including fractions > 1.

¼ x ½

Scaling by ½

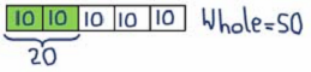
"finding a half of a quarter"

½ x ¼

"¼ of a ½": find a ½, then divide it by 4.

Encourage children to draw diagrams to represent situations or problems involving fractions
Model how to do this, for example:

$\frac{2}{5}$ of a number is 20. What is the number?



STARS schools Calculation Policy for Multiplication: Year 6

Informal methods to support mental Calculations

perform mental calculations, including with mixed operations and large numbers *(increasingly large numbers & more complex calculations)*

use all the multiplication tables to calculate mathematical statements in order to maintain fluency.

use estimation to check answers to calculations & determine, in the context of a problem, an appropriate degree of accuracy.

identify the value of each digit in numbers given to three decimal places and multiply and divide numbers by 10, 100 and 1000 giving answers up to three decimal places.

Use mental strategies to solve problems e.g.

- x4 by doubling and doubling again
- x5 by x10 and halving
- x20 by x10 and doubling
- x9 by multiplying by 10 and adjusting
- x6 by multiplying by 3 and doubling

Children should know the square numbers up to 12 × 12 & derive the corresponding squares of multiples of 10 e.g. 80 × 80 = 6400

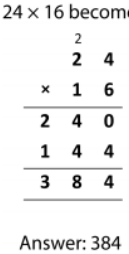
Written Calculations

Multiply multi- digit numbers up to 4 digits by a two digit whole number using the formal written (short and long multiplication)

Multiply one digit numbers with up to 2 decimal places by whole numbers.

Long Multiplication

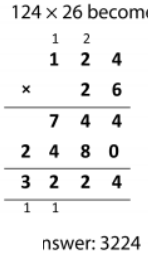
24 × 16 becomes



Answer: 384

124 × 26 becomes

124 × 26 becomes

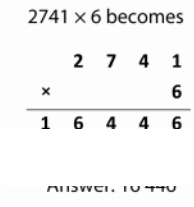


nswer: 3224

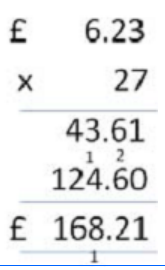
Does the answer seem sensible?

ThHTU x U Short Method

2741 × 6 becomes



Multiplying decimals



Representations to support mental

x	8	0.4	0.06
11	88	4.4	0.66

= 93.06

What's the same?
What's different?

$$\begin{array}{r} 8.46 \\ \times\ 11 \\ \hline 93.06 \end{array}$$

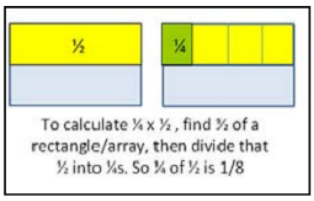
Look at long-multiplication calculations containing errors, identify the errors and determine how they should be corrected

Fractions

•multiply simple pairs of proper fractions, writing the answer in its simplest form e.g. ¼ x ½ = 1/8

Three key applications of understanding:

- Recognise that ¼ of 12, ¼ x 12 and 12 divided by 4 are equivalent
- Use cancellation to simplify the product of a fraction and an integer e.g. ⅕ x 15 = 3, ⅗ x 15 = 2 x ⅕ x 15 = 2x3 = 6
- Work out how many ⅕s in 15, how many ⅗s in 15, how many 2/5s in 1 etc.



To calculate ¼ x ½ , find ¼ of a rectangle/array, then divide that ½ into ¼s. So ¼ of ½ is 1/8

Pupils should use a variety of images to support their understanding of multiplication with fractions. This follows earlier work about fractions as operators (fractions of), as numbers, and as equal parts of objects, e.g. as parts of a rectangle.

Subtraction

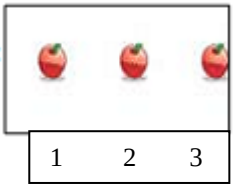
STARS schools Calculation Policy for Subtraction: Year 1

Mental Calculations

Subtract one digit and two digit numbers to 20, including zero.
Read, write and interpret mathematical statements using symbols (+, - , =) signs.
Represent and use number bonds and related addition facts within 20
Solve one step problems using concrete objects and pictorial representations, and missing number problems such as 4 = □ - 6

Memorise and reason with number bonds
Add using objects, Numicon, cubes etc and number lines and tracks
Check with everyday objects
Ensure pre-calculation steps are understood, including:
Counting objects,

Conservation of number



Written Calculations

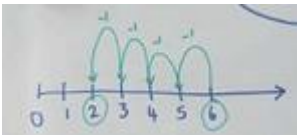
Subtract one digit and two digit numbers to 20, including zero.

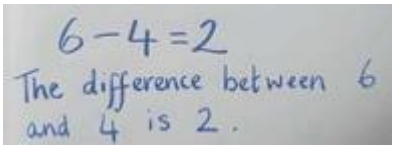
7 – 3 = □, 7 - □ = 4

□ - 3 = 4, 17 – 13 = □

17 - □ = 4

Read, write and interpret mathematical statements involving addition (+), subtraction (–) and equals (=) signs .





Represent and use number bonds and related subtraction facts within 20.

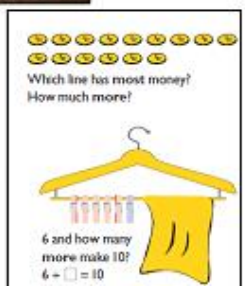
Representations to support mental and written calculations.

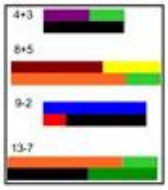
Use a range of concrete and pictorial representations, including:

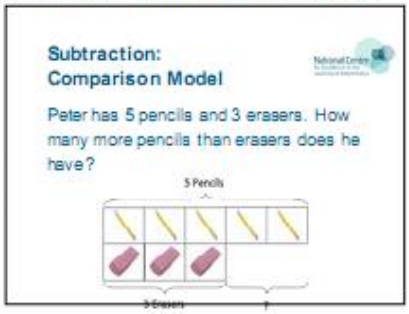
Straw bundles

Hands, and children themselves.

Bead strings, number tracks and lines







STARS schools Calculation Policy for Subtraction: Year 2

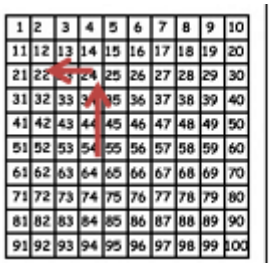
Mental Calculations

Add and subtract numbers using concrete objects, pictorial representations, and mentally, including:

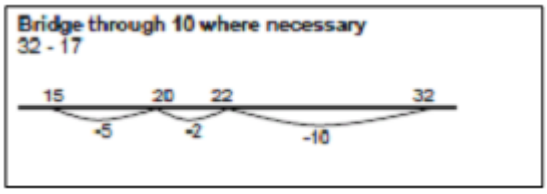
- x **a two digit number and ones**
- x **a two digit number and tens**
- x **two two digit numbers**
- x **adding three one digit numbers**

Jottings to support informal methods:

54—32 = 22



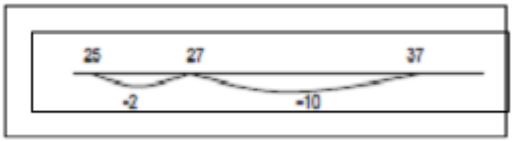
54—32 = 22

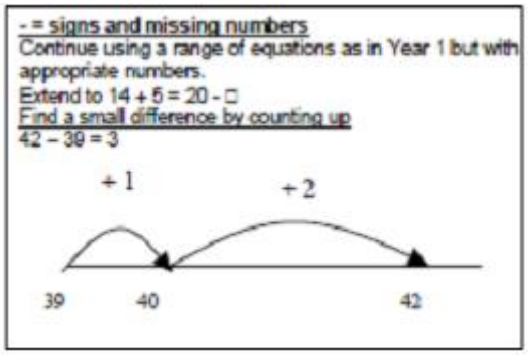


Written Calculations

Written recording:

37 – 12 = 37 – 10 – 2
= 27 – 2
= 25

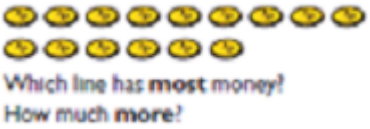




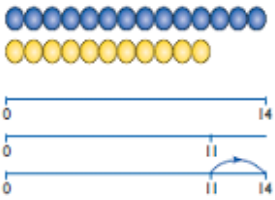
Representations to support mental and written calculations.

Informal methods to support written subtraction calculations

Practical portioning of a 2 digit number



In Year 1 leads to:



The difference between 11 and 14 is 3.
14 – 11 = 3
11 + □ = 14

Bundles of straws or dienes to represent and partition 2 digit numbers.
Subtract (without decomposition) using partitioning and equipment, e.g.

To calculate 35 · 22, remove 22.

Then record: **35 · 22=13**.

Continue to use of a range of concrete and pictorial representations from Year 1—including Bar model to support understanding of **difference.**

Fractions

Pupils should count in fractions up to 10, starting from any number and using the and equivalence on the number line (for example, 1 ¼, 1 ½, 1 ¾, 2.)

Use concrete and pictorial models of fractions to assist with counting e.g. paper cups, plates, shapes etc.

STARS schools Calculation Policy for Subtraction: Year 3

Mental Calculations

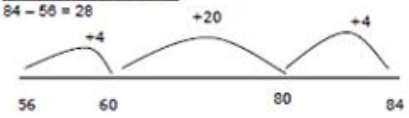
Add and subtract numbers mentally, including:
***a three digit number and ones**
***a three digit number and tens**
***a three digit number and hundreds.**

Use a number line, dienes, hundred squares, two hundred squares, and similar representations, to support mental calculations. (See Representations section below.)

Use known number facts and place value to subtract
Continue as in Year 2 but with appropriate numbers e.g.
97 – 15 = 72

With practice, children will need to record less information and decide whether to count back or forward. It is useful to ask children whether counting up or back is the more efficient for calculations
such as 57 – 12, 86 – 77 or 43 – 28.

Pencil and paper procedures
Complementary addition
84 – 56 = 28



Written Calculations

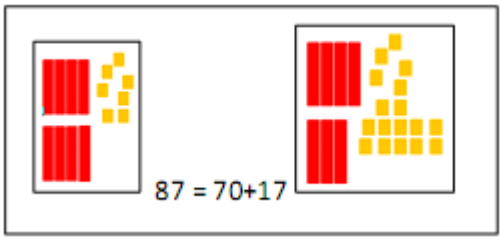
Add and subtract numbers with up to three digits, using formal written methods of columnar addition and subtraction.

(1)Extended columnar - no exchange

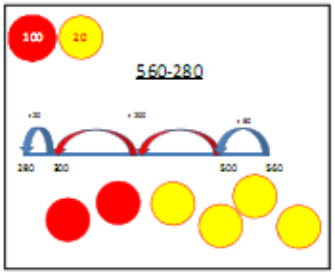
Extended method 87 - 53 =

80 and 7
- 50 and 3
30 and 4 = 34

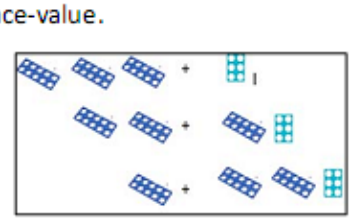
(2) Extended columnar – with exchange:
87-58 becomes
70 + 17
-50 + 8
20 + 9



Representations to support mental and written calculations.



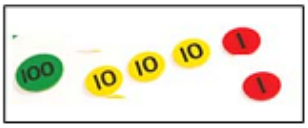
Partitioning and re- partitioning support the understanding of place-value.



All of these representations still comprise the amount of 36.

Introduce transition from concrete place value representations, (e.g. dienes or straws), to pictorial – such as place value counters or money.

132 in dienes



132 in place value counters.

Revert to concrete manipulatives and expanded methods whenever difficulties arise

Fractions

Count up and down in tenths.
Add and subtract fractions with the same denominator and within one whole.

Bar Model

$\frac{1}{6} + \frac{1}{6} + \frac{1}{6} = \frac{3}{6} = \frac{1}{2}$

STARS schools Calculation Policy for Subtraction: Year 4

Mental Calculations

Continue to practise mental methods with increasingly large numbers to aid fluency. *(From Non– Statutory Guidance).*

Methods to support fluent calculation and encourage efficiency of method:

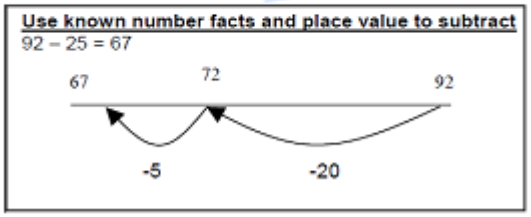
x Find a small difference by counting up.
E.g. 5003—4996

x Subtract nearest multiple of ten and adjust.

x Partition larger numbers

Whenever possible, children should be encouraged to visualise number lines and other basic, supporting representations to promote fluent work without jottings.

This could be done using an empty number line. Children should recall and use number facts to reduce the number of steps.



Written Calculations

Add and subtract numbers with up to 4 digits using the formal written methods of columnar addition and subtraction where appropriate (including inverses and money)

Build on formal, extended method (*See Year 3)* using exchange wherever necessary.

Continue to use representations and manipulatives to develop understanding of place value.

372—147 =

300 + 70 + 2
-100 + 40 + 7

→

300 + 60 + 12
-100 + 40 + 7
200 + 20 + 5

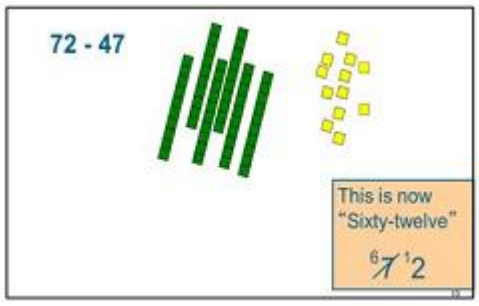
→

60 1
300 + 70 + 2
- 100 + 40 + 7
200 + 20 + 5

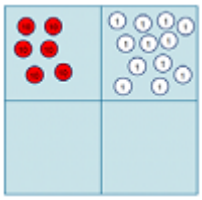
Apply understanding of subtraction with larger integers to that of decimals in context of money and measures.

£ 5 4. 2 3
£ 1 2 . 1 2
£4 2. 1 1

Representations to support mental and written calculations.



Dienes blocks or place value counters can be used to model calculations and the underlying place value concepts.



Use physical and / or pictorial representations and expanded algorithms alongside columnar methods. Ask: *What is the same? What's different?*

Compare and discuss the suitability of different methods in context.

Pupils **decide which operations and methods to use and why.**

I would count on using a number line to calculate : 5003 - 4896; because the numbers are close together.

STARS schools Calculation Policy for Subtraction: Year 5

Mental Calculations

- **Subtract numbers mentally with increasingly large numbers.**
  E.g. 12 462 – 2300 = 10 162
- **Use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy .**
- ***Pupils practise adding and subtracting decimals, including a mix of whole numbers and decimals, decimals with different numbers of decimal places, and complements of 1 (for example, 1 - 0.17 = 0.83).***
- ***Pupils mentally add and subtract tenths, and one-digit whole numbers and tenths.***

Basic Mental Strategies for Subtraction

- Find differences by counting up
- Partitioning
- Applying known facts
- Bridging through 10 and multiples of 10
- Subtracting 9, 11 etc. by compensating
- Counting on to, or back from the largest number

National Curriculum 1999

Which method works best? Why? How else could we do it?

Children use of visualize the representation of choice. Referring back to physical representations as needed.

Written Calculations

Add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction)

(Pupils) practise adding and subtracting decimals.

Begin with three-digit numbers using formal, columnar method; then move into four-digit numbers.

As in Year 4, compare physical and / or pictorial representations and expanded algorithms alongside columnar methods. Ask: *What is the same? What's different?*
Compare and discuss the suitability of different methods, (mental or written), in context.
Revert to expanded methods whenever difficulties arise

£17.34—£12.16

What is the same about these models? What's different?

1000+700+20+14p
- 1000+200+10+ 6p
500+10+ 8p

→

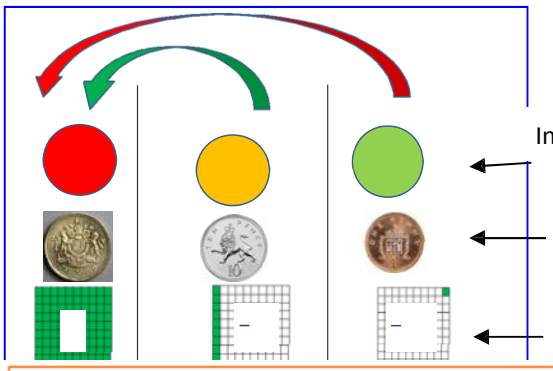
2
1734p
- 1216p
518p

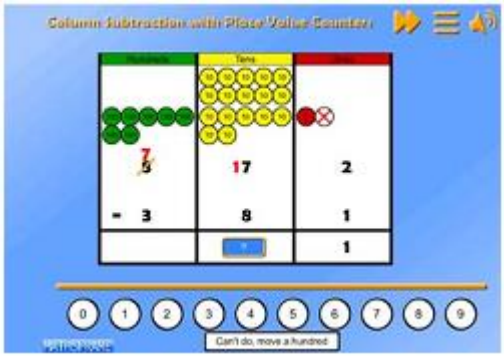
→

£ 2
17.34
- 12.16
5.18

Relate place value of decimals with that of whole numbers using representations. See below.

Representations to support written and mental calculations





Use physical and pictorial representations to stress the place value relationships between money, decimals and whole numbers. A place value mat such as the this one could be used, moving away from the traditional: *Hundreds, tens and ones* model used in Lower KS2 and KS1.

Fractions

Subtract fractions with the same denominator and denominators that are multiples of the same number. (*Include fractions exceeding 1 as a mixed number.)*
Solve problems involving number up to three decimal places .
They mentally add and subtract tenths, and one-digit whole numbers and tenths.

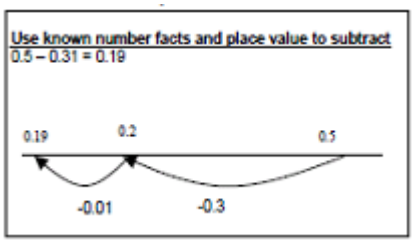
STARS schools Calculation Policy for Subtraction: Year 6

Mental Calculations

Children:

- **Perform mental calculations, including with mixed operations and large numbers.**
- **Use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.**
- ***They undertake mental calculations with increasingly large numbers and more complex calculations.***

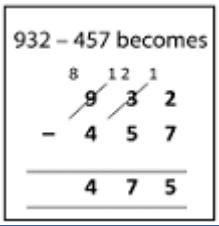
Children draw on basic, Mental subtraction Strategies, (See Year 5.)
Children use, or visualise, representation of choice.
Refer back to physical representations as required.



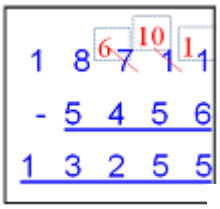
Written Calculations

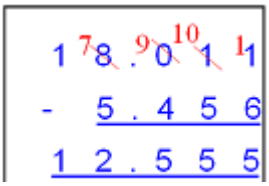
Add and subtract whole numbers with including and exceeding 4 digits (including decimals), including using formal written methods (columnar addition and subtraction). Solve problems involving the calculation and conversions of units of measure, using decimal notation of up to three decimal places where appropriate.

Move towards consolidation of formal, columnar method.
For more complex calculations, with increasingly larger or smaller numbers, compare representations and expanded algorithms alongside columnar methods. Ask: What is the same? What's different?
Compare and discuss the suitability of different methods, (mental or written), in context. Revert to expanded methods whenever difficulties arise.



Consolidate columnar methods , paying particular attention to the occurrence of zeros as place holders.

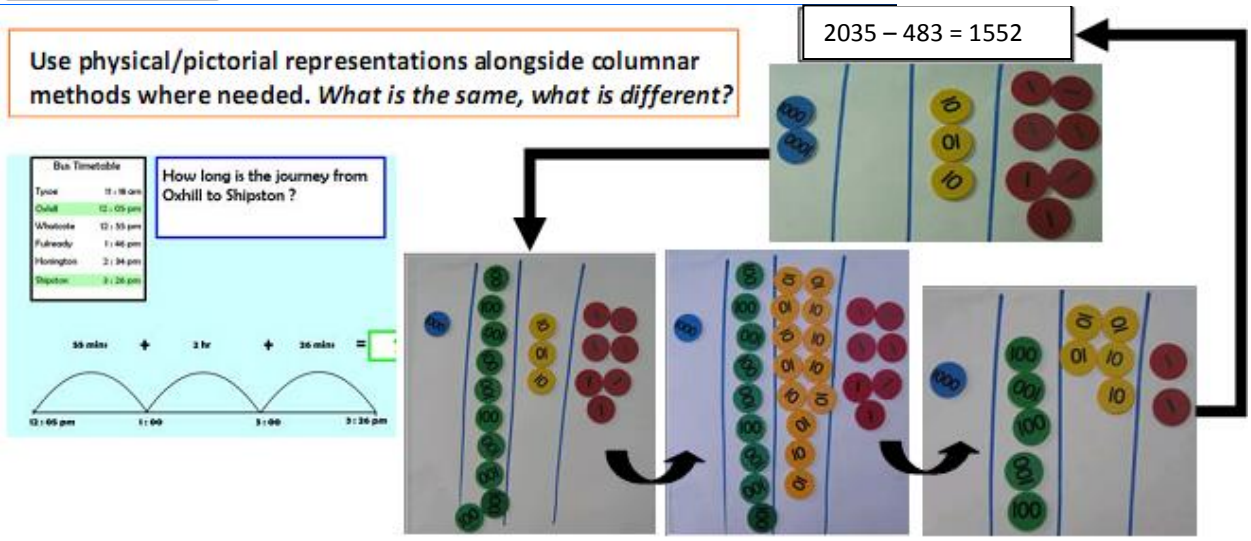




Note: Crossing out on the top line

Representations to support mental and written calculations.

Use physical/pictorial representations alongside columnar methods where needed. *What is the same, what is different?*



Fractions

Add and subtract fractions with different denominators and mixed numbers.
They practise calculations with simple fractions and decimal fraction equivalents to aid fluency.