Giles Junior School

Parents' Guide to Calculations

Introduction

This policy outlines the school's agreed progression through written strategies for addition, subtraction, multiplication and division, beginning in Year 1 and progressing to Year 6. Children should work through the progression in order that they can use, understand and explain a compact standard method for each operation by the end of Year 6. Although the progression is broken-down into year groups, children should of course move at the pace appropriate to them, though we would expect the majority of each class to be working at an age-appropriate level. The policy also includes examples and diagrams, showing how we expect calculations to be taught, as consistency in layout and presentation is important to support learning. Use of the progression and the teaching of strategies which are appropriate for each child's age and ability will be regularly monitored through planning scrutiny, work sampling and pupil interviews.

The importance of mental maths

While this policy focuses on strategies for written calculations in maths, it is important to remember that mental strategies and known facts form the basis of all calculations. The following checklists outlines the key skills and number facts that children should develop throughout the school:

To add and subtract successfully, children need to be able to:

- Recall all addition pairs to 9 + 9 and number bonds to 10
- Recognise addition and subtraction as inverse operations
- Add mentally a series of one-digit numbers (eg. 5 + 8 + 4)
- Add and subtract multiples of 10 or 100 (eg. 600 + 700, 160—70) using the related addition fact and their knowledge of place value
- Partition 2-digit and 3-digit numbers into multiples of 100, 10 and 1 in different ways (eg. partition 74 into 70 + 4 or 60 + 14)
- Illustrate a thorough understanding of place value

To multiply and divide successfully, children need to be able to:

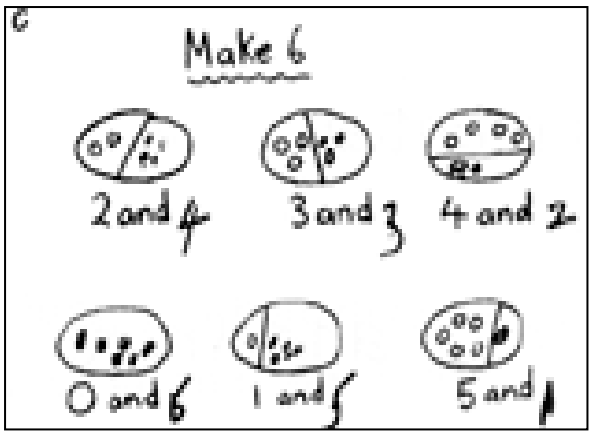
- Recall all multiplication facts to 10x10
- Work out products such as 70 x 5, 70 x 50, 700 x 5 or 700 x 50 using the related fact 7 x 5 and their knowledge of place value— including the patterns of multiplying and dividing by the powers of ten
- Add two or more single-digit numbers mentally
- Add multiples of 10 or 100 using related addition facts
- Partition 2– and 3-digit numbers into multiples of 100, 10 and 1 in different ways
- Understand and use multiplication and division as inverse operations
- Understand and use the vocabulary of division
- Know subtraction facts to 20 and use this knowledge to subtract multiples of 10 (eg. 120-80, 320-90)
- Use tables knowledge to estimate how many times one number divides into another (eg. how many 6s are there in 47, or how many 23s are there in 92)

The use of calculators should be encouraged in all year groups to check answers

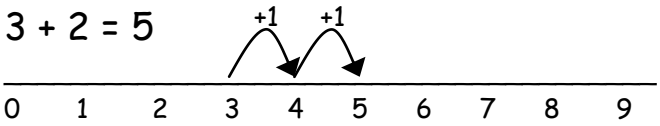
Where possible SAT style questions should be used as lesson plenaries

Addition

Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures, etc.

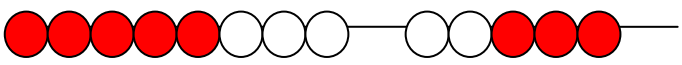


They use numberlines and practical resources to support calculation and teachers *demonstrate* the use of the numberline.



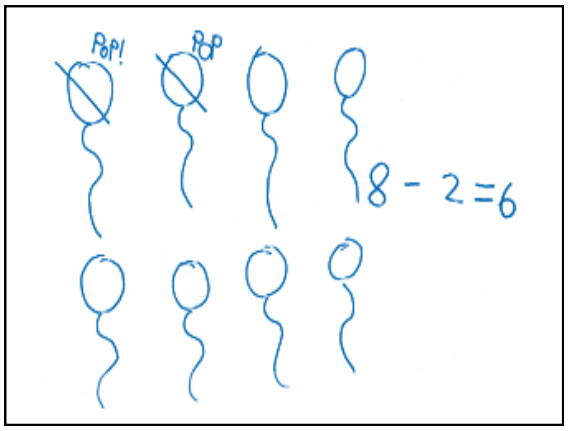
Children then begin to use numbered lines to support their own calculations using a numbered line to count on in ones.

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

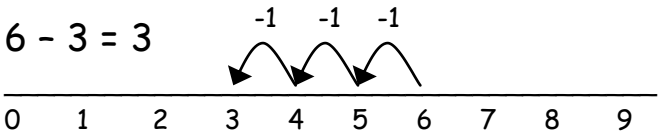


Subtraction

Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures etc.

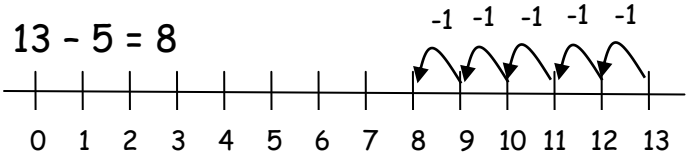


They use numberlines and practical resources to support calculation. Teachers *demonstrate* the use of the numberline.

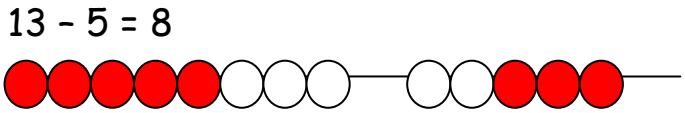


The numberline should also be used to show that 6 - 3 means the 'difference between 6 and 3' or 'the difference between 3 and 6' and how many jumps they are apart.

Children then begin to use numbered lines to support their own calculations - using a numbered line to count back in ones.



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

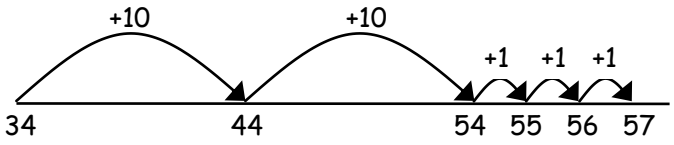


Addition

Children will begin to use 'empty number lines' themselves, starting with the larger number and counting on.

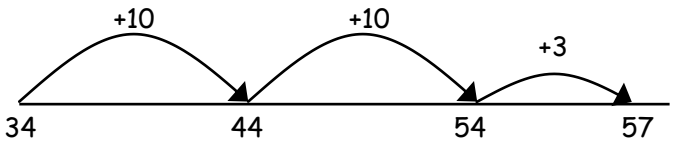
First counting on in tens and ones:

34 + 23 = 57



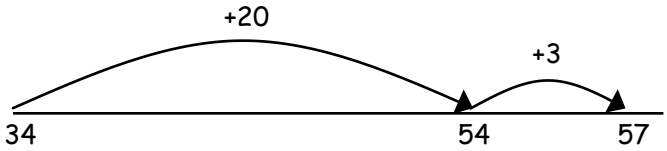
Then helping children to become more efficient by adding the units in one jump (by using the known fact 4 + 3 = 7):

34 + 23 = 57



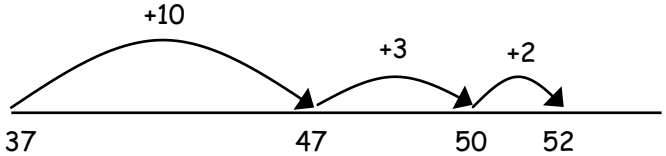
Followed by adding the tens in one jump and the units in one jump:

34 + 23 = 57



Bridging through ten can help children become more efficient:

37 + 15 = 52



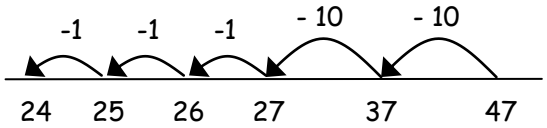
Subtraction

Children will begin to use empty number lines to support calculations.

Counting back

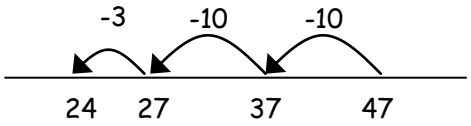
First counting back in tens and ones.

47 – 23 = 24



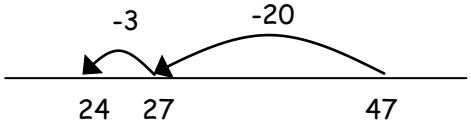
Then helping children to become more efficient by subtracting the units in one jump (by using the known fact 7 – 3 = 4).

47 – 23 = 24



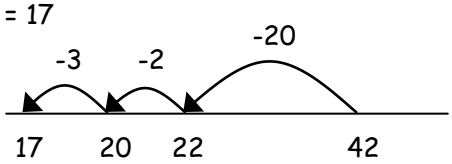
Subtracting the tens in one jump and the units in one jump.

47 – 23 = 24



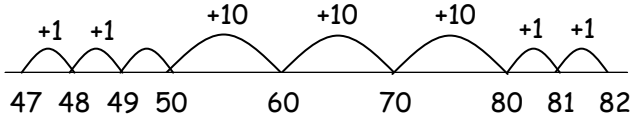
Bridging through ten can help children become more efficient.

42 – 25 = 17



Counting on to find the difference

Children should learn that if the numbers involved in the calculation are close together or near to multiples of 10, 100 etc, it can be more efficient to count on:

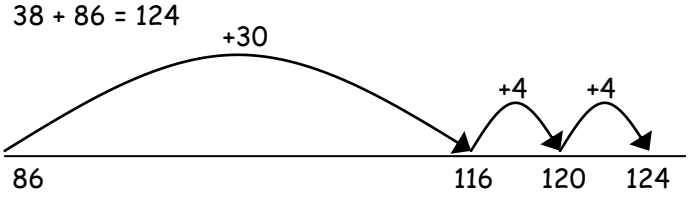


Addition

Children continue to use empty number lines with increasingly large numbers, including compensation as an understanding for a mental strategy.

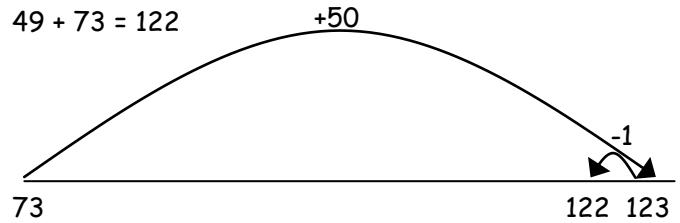
Count on from the largest number irrespective of the order of the calculation:

38 + 86 = 124



Compensation:

49 + 73 = 122



Children begin to use informal pencil and paper methods (jottings) to support, record and explain partial mental methods building on existing mental strategies.

Horizontal partitioning

67 + 24

60 + 20 7 + 4

60 + 20 = 80
7 + 4 = 11 80 + 11 = 91

Then move to adding least significant digits using columns, in preparation for 'carrying':

```
  67
+ 24
  11 ( 7 + 4)
  80 (60 + 20)
  91
```

```
  267
+ 85
  12 ( 7 + 5)
 140 (60 + 80)
 200
 352
```

Subtraction

Number lines

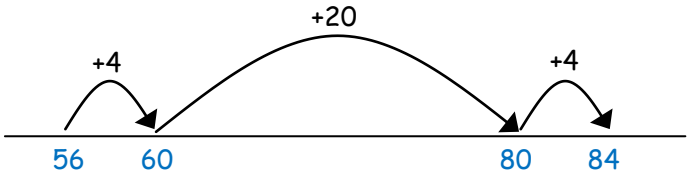
Develop counting on and counting back with an empty number line Children develop an understanding of when it is appropriate to count back and when to count on, eg:

93 - 5 (count back)
93 - 78 (count on)

This should be extended to enable children to find the difference between any pair of 2 or 3-digit numbers

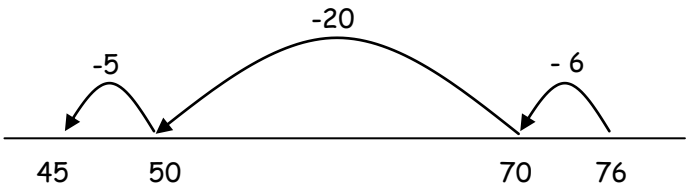
Complementary addition
Use alongside a 100 grid.
Children use the vertical method of recording counting-on (complimentary addition) alongside number lines to make process clearer and prepare children for more formal methods:

84 - 56 = 4 + 20 + 4 = 28




```
  84
- 56
   4 (60)
  20 (80)
   4 (84)
  28
```

Number line decomposition:
76 — 45 =




```
  76
- 45
   6 (70)
  20 (50)
   5 (45)
  31
```

Addition

Children build on expanded vertical addition methods introduced earlier, simplifying and beginning to carry below the line.

HTU	HTU	HTU
625	783	367
+ 48	+ 42	+ 85
673	825	452
1	1	1 1

Using similar methods, children will:

- add several 2– and 3-digit integers with different numbers of digits
- begin to add two or more three-digit sums of money, recognising that the decimal points should line up under each other, particularly when adding or subtracting mixed amounts, eg. £3.59 + 78p.
- continue to show understanding of the written method chosen when the calculation includes zero as a place holder

Subtraction

Children continue to use counting-up (complimentary addition), using informal notes or jottings, before being introduced to decomposition.

Expanded decomposition leads to compact method:

754 = 700 50 4
\- 86 - 80 6

= 700 40 14
\- 80 6

= 600 140 14
\- 80 6
600 60 8

= 668

Use place value cards and diennes blocks to illustrate this.

Leading to:

600 140 1
~~700~~ + ~~50~~ + 4
\- 80 + 6
600 + 60 + 8 = 668

Leading to:

6 1 4 1
~~7~~ ~~5~~ 4
\- 8 6
6 6 8

By the end of the year, children will be:

- confident in the use of decomposition to find the difference between two 2– or 3-digit integers
- begin to find the difference between two sums of money, recognising that the decimal points should line up under each other

Addition

Children extend the carrying method to numbers with at least four digits.

```
  587          3587
+ 475        +  675
 1062         4262
  1 1          1 1 1
```

Using similar methods, children will:

- add several integers with different numbers of digits (up to ThHTU);
- begin to add two or more decimals with the same number of decimal places;
- know that decimal points should line up under each other.

Subtraction

Decomposition should now be extended to ThHTU and decimals, eg:

```
  3 7 5 4          7 5 . 8
- 1 2 8 6        - 6 7 . 9
  2 4 6 8          7 . 9
```

Children should:

- be able to subtract numbers with different numbers of digits;
- begin to find the difference between two decimals with up to three digits and the same number of decimal places;
- know that decimal points should line up under each other.

Addition

Children extend the carrying method to number with any number of digits.

7648	658.4	42
+ 1486	+ 58.48	6432
9134	716.88	786
1 1 1	1 1	3
		+ 4681
		11944
		1 2 1

Using similar methods, children will

- add several numbers with different numbers of digits;
- add two or more decimals with up to four digits and either one or two decimal places;
- know that decimal points should line up under each other, particularly when adding or subtracting mixed amounts, e.g. 401.2 + 26.85 + 0.71.

Subtraction

Children extend their use of decomposition to include decimals with different numbers of decimal places:

5 $\overset{6}{\not{7}}$. $\overset{1}{\not{2}}\overset{10}{0}$	7 $\overset{6}{\not{0}}\overset{9}{\not{0}}\overset{9}{\not{0}}\overset{1}{0}$. 8 3
- 1 2 . 8 6	- 2 9 7 8 . 0 0
4 4 . 3 4	4 0 2 2 . 8 3

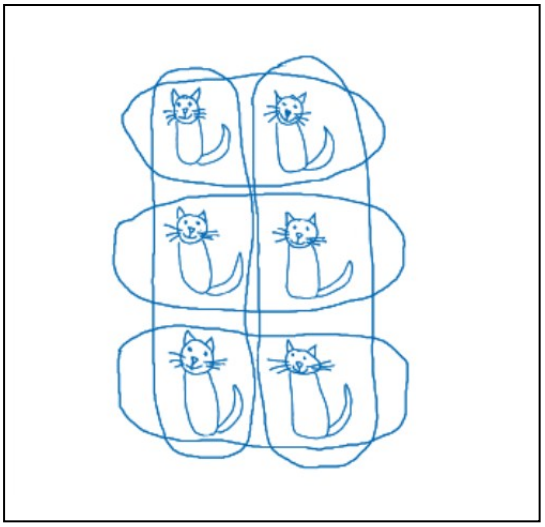
Put the place holders in

Children should:

- be able to subtract numbers with different numbers of digits;
- be able to find the difference between two decimals with one or two decimal places
- know that decimal points should line up under each other.

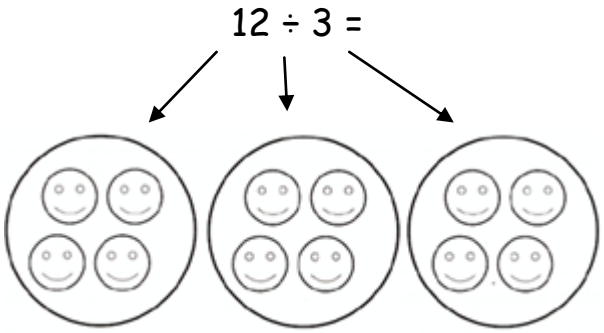
Multiplication

Children will experience equal groups of objects and will count in 2s and 10s and begin to count in 5s. They will work on practical problem solving activities involving equal sets or groups.



Division

Children will understand equal groups and share items out in play and problem solving. They will count in 2s and 10s and later in 5s.



Multiplication

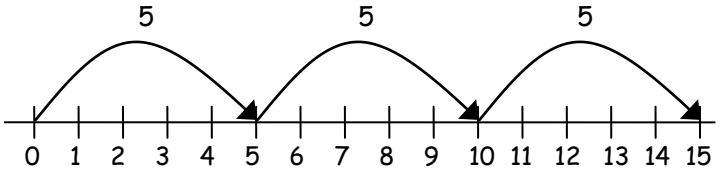
Children will develop their understanding of multiplication and use jottings to support calculation:

Repeated addition

3 times 5 *is* 5 + 5 + 5 = 15 *or* 3 lots of 5 *or* 5 x 3

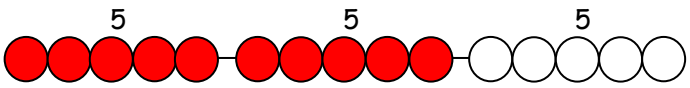
Children learn that repeated addition can be shown on a number line:

5 x 3 = 5 + 5 + 5



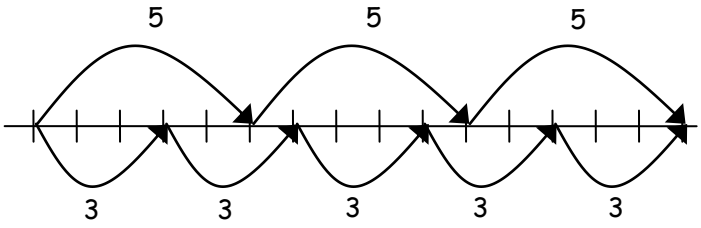
and on a bead bar:

5 x 3 = 5 + 5 + 5



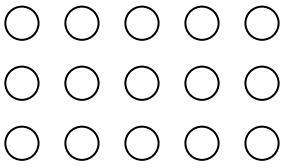
Commutativity

Children should learn that 3 x 5 has the same answer as 5 x 3. This can also be shown on the number line.



Arrays

Children should be able to model a multiplication calculation using an array. This knowledge will support their understanding of commutativity and with the development of the grid in a written method.



5 x 3 = 15

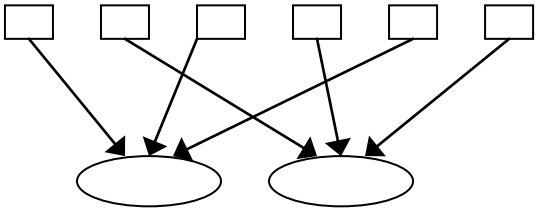
3 x 5 = 15

Division

Children will develop their understanding of division and use jottings to support calculation -

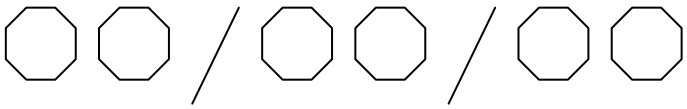
Sharing equally:

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



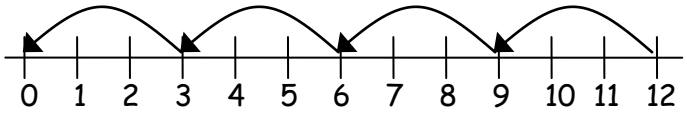
Grouping or repeated subtraction:

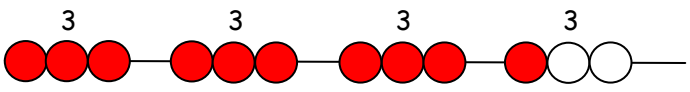
There are 6 sweets, how many people can have 2 sweets each?



Repeated subtraction using a number line or bead bar:

12 ÷ 3 = 4





The bead bar will help children with interpreting division calculations, recognising that 10 ÷ 5 can also be seen as 'how many 5s make 10?'

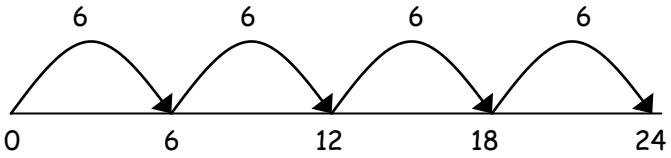
Multiplication

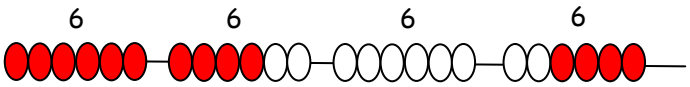
Children continue to use:

Repeated addition

4 times 6 is 6 + 6 + 6 + 6 = 24
or 4 lots of 6
or 6 x 4

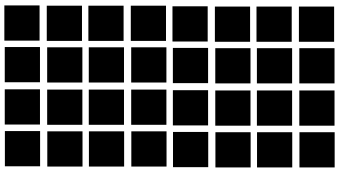
Children should use number lines or bead bars to support their understanding.





Arrays

Children learn to model a multiplication calculation using an array. This knowledge will support them with the development of the grid method.



9 x 4 = 36

9 x 4 = 36

Children use symbols to stand for unknown numbers and complete equations using inverse operations

□ x 5 = 20 3 x Δ = 18 □ x O = 32

Division

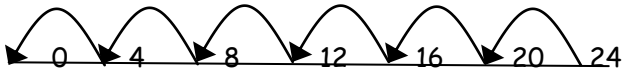
it is important for children to recognise that division can be seen as grouping as well as sharing.

Children continue to use:

Repeated subtraction using a number line

Children will use an empty number line to support their calculation.

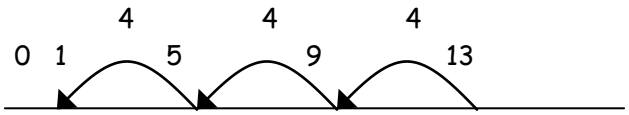
24 ÷ 4 = 6



Children to write their times table horizontally along the line first to aid them.

Children then move onto calculations involving remainders.

13 ÷ 4 = 3 r 1

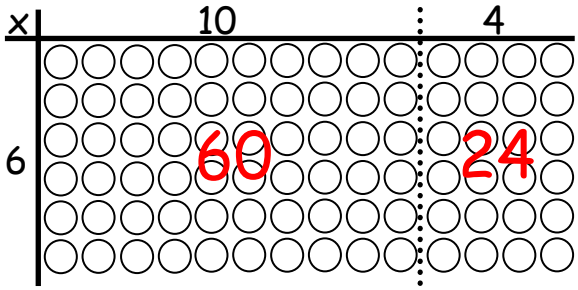


Children begin to understand the use of symbols to stand for unknown numbers to complete equations using inverse operations

26 ÷ 2 = □ 24 ÷ r = 12 □ ÷ 10 = 8

Multiplication

Continue to use arrays as a visual method to develop understanding of grid method of multiplication.



6 x 14 = (6 x 10) + (6 x 4) = 60 + 24 = 84

Grid method

Should be introduced for multiplication of TU x U and HTU x U (using clear column addition methods to find the total):

23 x 8

Children will approximate first
23 x 8 is approximately 25 x 8 = 200

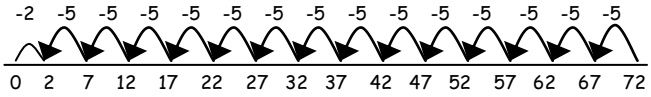
x	20	3
8	160	24

160
+ 24
184

Division

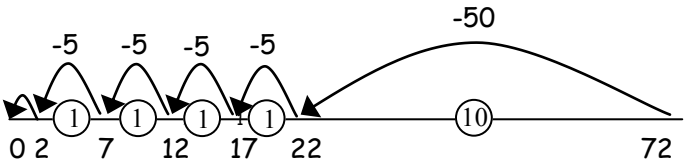
Children develop the use of repeated subtraction to be able to subtract multiples of the divisor. Initially, these should be multiples of 10s, 5s, 2s and 1s – numbers with which the children are more familiar.

72 ÷ 5



= 14 r 2

Moving onto:



Then onto the vertical method (chunking):

	72	
-	50	(10 x 5)
	22	
-	10	(2 x 5)
	12	
-	10	(2 x 5)
	2	
Answer :		14 r 2

Ensure that you write the number you are dividing by on the right and side and that you underline the multiple

Leading to subtraction of other multiples, eg:

78 ÷ 3 =		78	
	-	30	(10 x 3)
		48	
	-	30	(10 x 3)
		18	
	-	18	(6 x 3)
		0	
	Answer :		26

Remainders should be given as integers, but children need to be able to decide what to do after division, rounding up or down accordingly, eg:

- I have 62p. How many 8p sweets can I buy? (Answer: 7 - round down)
- Apples are packed into boxes of 8. There are 62 apples. How many boxes are needed? (Answer: 8 - round up)

Multiplication

Children extend their use of the grid method to include:

- **HTU x U, eg. 346 x 9**

  Approximate first:
  346 x 9 is approximately 350 x 10 = 3500

x	300	40	6
9	2700	360	54

```
  2700
   360
+   54
  3114
  1 1
```

- **TU x TU, eg. 72 x 38**

  Approximate first:
  72 x 38 is approximately 70 x 40 = 2800

x	70	2
30	2100	60
8	560	16

```
  2100
+  560
+   60
+   16
  2736
  1
```

Children also begin to develop an understanding of partitioning

38 x 5 = (30 x 5) + (8 x 5)
= 150 + 40
= 190

Division

Children continue to use chunking methods to solve TU ÷ U and HTU ÷ U, using increasingly efficient methods and larger multiples of the divisor (20x, 30x), eg:

196 ÷ 6 =

```
  196
- 180   (30 x 6)
   16
-  12   (2 x 6)
    4
```

Answer = 32 r 4

Children learn to show quotients as fractions, eg. 196 ÷ 6 = 32 r 4 = $32\ ^{4}/_{6} = 32\ ^{2}/_{3}$

Children develop their understanding of rounding answers up or down in context.

Short division

196 ÷ 6 =

```
    0 3 2 r 4
  ┌─────
6 │ 1¹9¹6
```

Multiplication

Children use their use of the grid method to extend to multiplying decimals:

- **U.t x U, eg. 4.9 x 3**

Approximate first:

4.9 x 3 is approximately 5 x 3 = 15

x	4	0.9
3	12	2.7

$$\begin{array}{r} 12 \\ +\ 2.7 \\ \hline 14.7 \end{array}$$

Children extend their use of the grid method to include:

- **ThHTU x U, eg. 4346 x 8**
- **HTU x TU, eg. 372 x 24**
- **U.th x U, eg. 4.92 x 3**

Division

Children extend use of chunking to:

- **HTU ÷ TU, eg 977 ÷ 36**

$$\begin{array}{rl} 977 & \\ -\ 720 & (20 \times 36) \\ 257 & \\ -\ 252 & (7 \times 36) \\ 5 & \end{array}$$

Answer = 27 r 6 = $27\ ^{5}/_{36}$