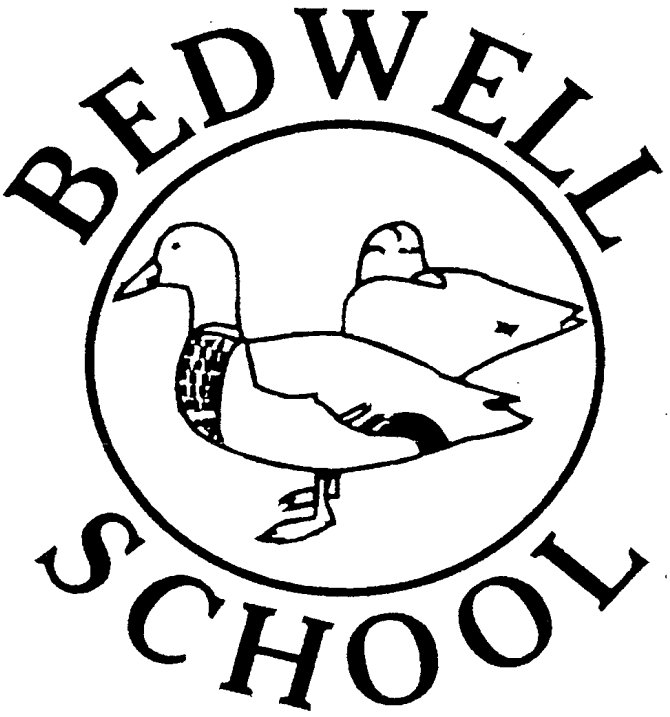


Calculation Policy

BEDWELL PRIMARY SCHOOL
Bedwell Crescent,
Stevenage, Herts, SG1 1NJ

Updated August 2014

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, updated to reflect the new 2014 primary curriculum . 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

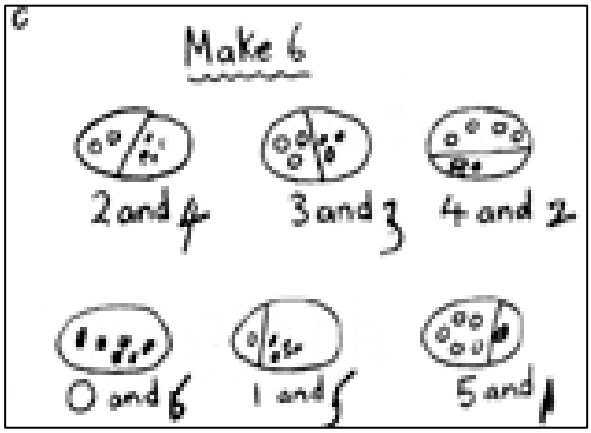
To multiply and divide successfully, children need to be able to:

- Recall all multiplication facts to 12x12
- 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 10)
- 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)

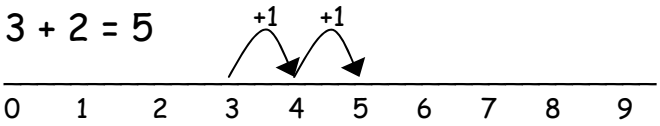
Year 1

Addition

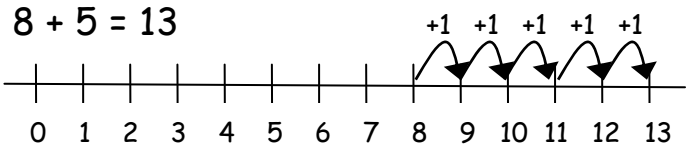
Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures, etc.



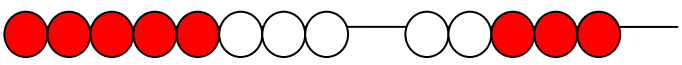
They use numberlines and practical resources to support calculation and teachers *demonstrate* the use of the numberline.



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

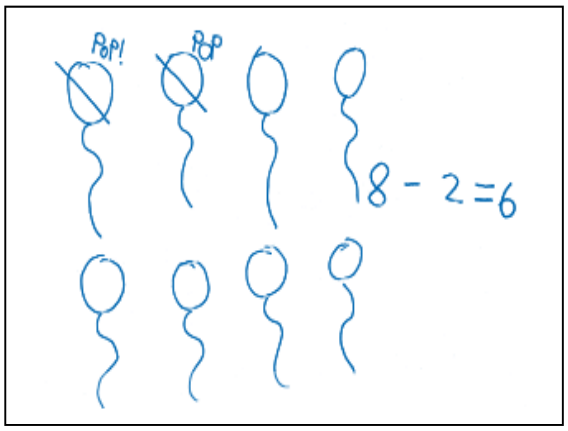


Bead strings or bead bars can be used to illustrate addition including bridging through ten by counting on 2 then counting on 3.

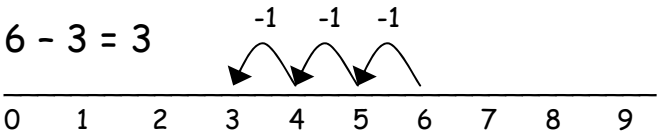


Subtraction

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.

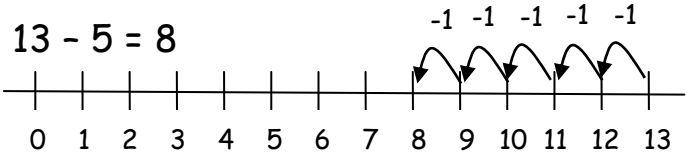


They use numberlines and practical resources to support calculation. Teachers *demonstrate* the use of the numberline.

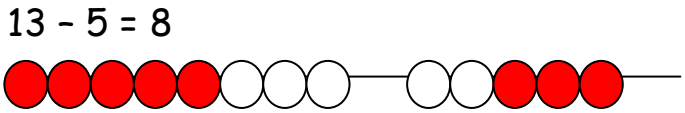


The numberline should also be used to show that 6 - 3 means the 'difference between 6 and 3' or 'the difference between 3 and 6' and how many jumps they are apart.

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



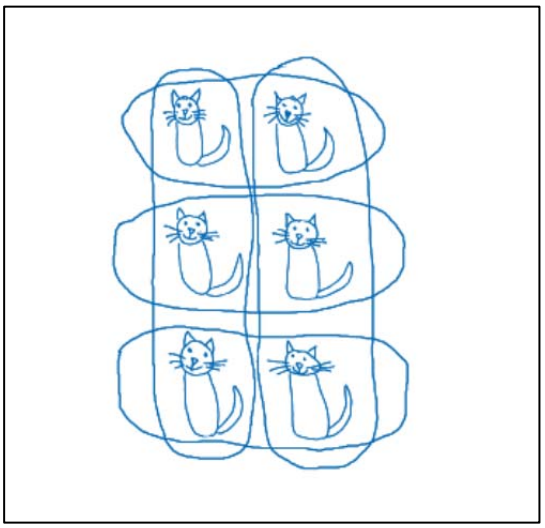
Bead strings or bead bars can be used to illustrate subtraction including bridging through ten by counting back 3 then counting back 2.



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 problem solving activities involving equal sets or groups, using:

- concrete objects
- pictorial representations
- arrays (with adult support)



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.

They should be introduced to division as both grouping and sharing - eg. this could represent either
12 ÷ 4 = 3 or 12 ÷ 3 = 4

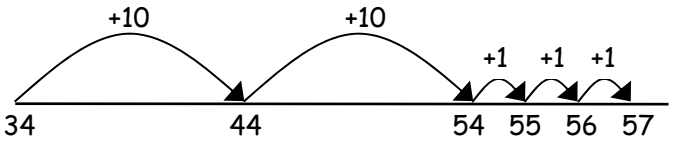
Year 2

Addition

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

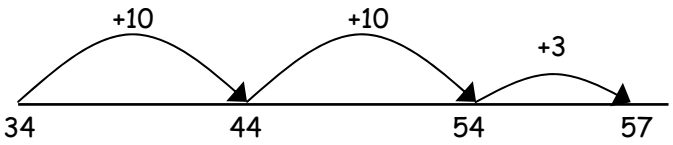
First counting on in tens and ones:

34 + 23 = 57



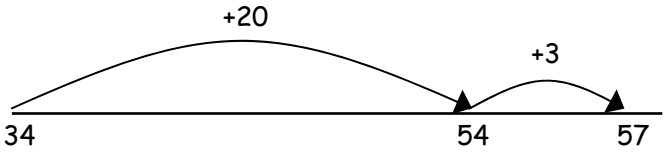
Then helping children to become more efficient by adding the units in one jump (by using the known fact 4 + 3 = 7):

34 + 23 = 57



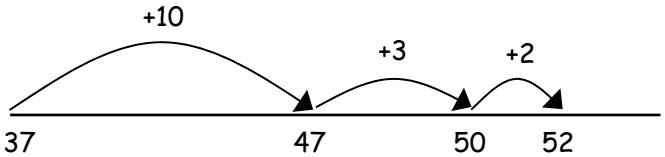
Followed by adding the tens in one jump and the units in one jump:

34 + 23 = 57



Bridging through ten can help children become more efficient:

37 + 15 = 52



Children should also learn to add 3 one-digit numbers, and from this identify that addition can be done in any order.

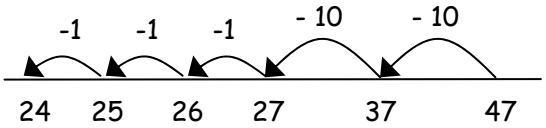
Subtraction

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

Counting back

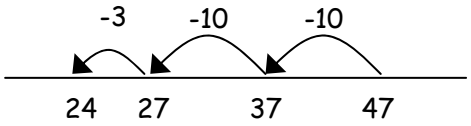
First counting back in tens and ones.

47 – 23 = 24



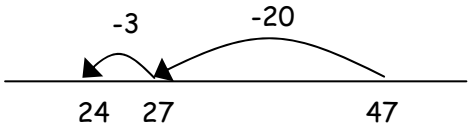
Then helping children to become more efficient by subtracting the units in one jump (by using the known fact 7 – 3 = 4).

47 – 23 = 24



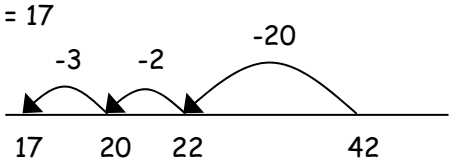
Subtracting the tens in one jump and the units in one jump.

47 – 23 = 24



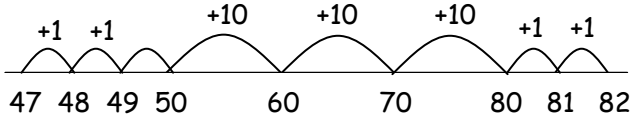
Bridging through ten can help children become more efficient.

42 – 25 = 17



Counting on

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:



Multiplication

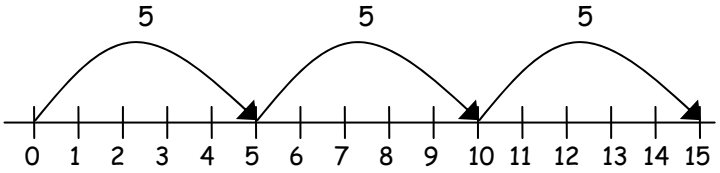
Children will develop their understanding of multiplication and use jottings to support calculation:

Repeated addition

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

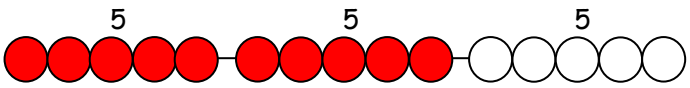
Children learn that repeated addition can be shown on a number line:

5 x 3 = 5 + 5 + 5



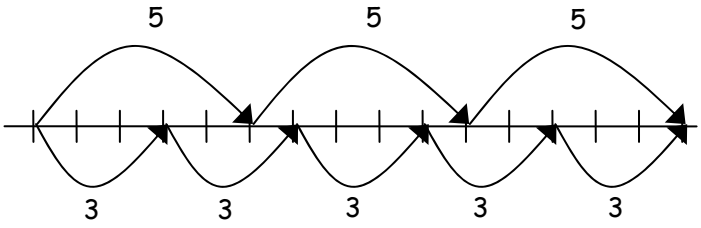
and on a bead bar:

5 x 3 = 5 + 5 + 5



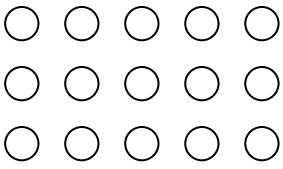
Commutativity

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 the development of the grid in a written method.



5 x 3 = 15

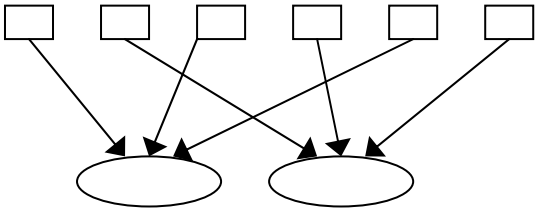
3 x 5 = 15

Division

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

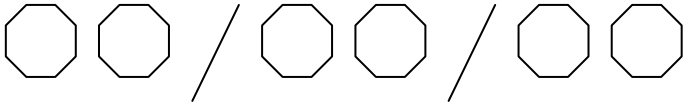
Sharing equally:

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



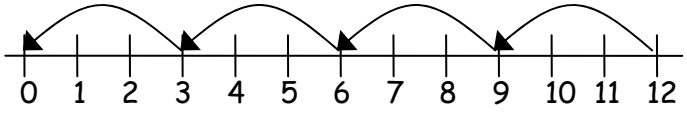
Grouping or repeated subtraction:

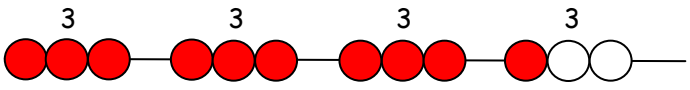
There are 6 sweets, how many people can have 2 sweets each?



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?' This, in turn, can be used to explicitly link division facts to tables knowledge

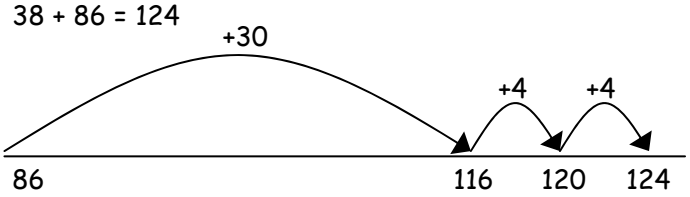
Year 3

Addition

Children continue to use empty number lines with increasingly large numbers, including compensation where appropriate.

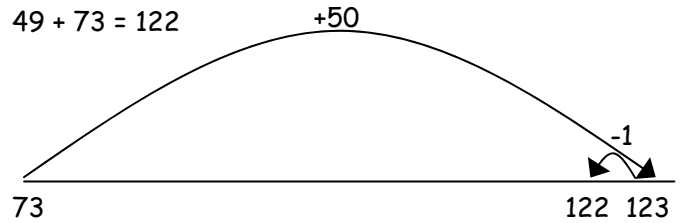
Count on from the largest number irrespective of the order of the calculation:

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.

Adding most significant digits first, using 2-digit and 3-digit numbers:

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

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

Once this is secure, children should be introduced to formal column addition up to HTU + HTU when they are ready (see Year 4 for examples)

Subtraction

Number lines

Develop counting on and counting back with an empty number line (see Year 2). Children develop an understanding of when it is appropriate to count back and when to count on, eg:

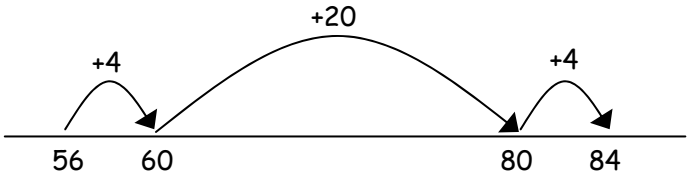
93 - 5 (count back)
93 - 78 (count on)

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

Complimentary addition

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

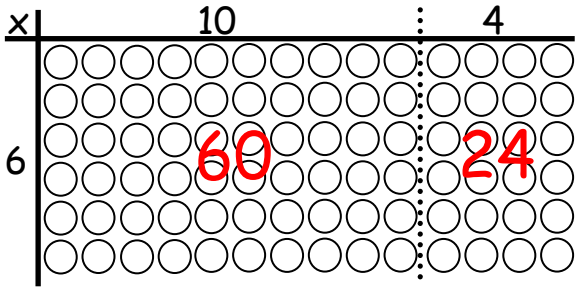



```
  84
- 56
   4  (60)
  20  (80)
   4  (84)
  28
```

Once this is secure, children should be introduced to formal column subtraction up to HTU - HTU when they are ready (see Year 4 for examples). It is important that practical / visual methods are used initially to support children in understanding what they are doing when they 'knock next door' (ie. what decomposition involves, rather than just learning a trick that gets the right answer).

Multiplication

Children continue to use arrays where appropriate leading into the 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

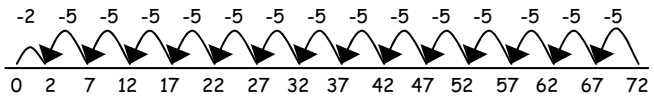
x	20	3
8	160	24

160
+ 24
184

Division

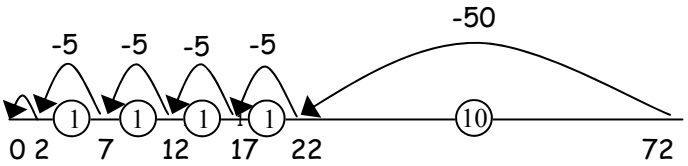
Children develop the use of repeated subtraction to be able to subtract multiples of the divisor. Initially, these should be multiples of 10s, 5s, 2s and 1s – numbers with which the children are more familiar.

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

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)

Year 4

Addition

Children build on expanded vertical addition methods introduced in Year 3, simplifying and beginning to carry below the line.

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

By the end of the year, children should confidently be able to total pairs of 4-digit numbers, checking their answers using estimation.

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 and 50 and 4
\- 86 - 80 and 6

= 700 and 40 and 14
\- 80 and 6

= 600 and 140 and 14
\- 80 and 6
600 and 60 and 8

= 668

Leading to:

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

Leading to:

6 14 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 3– or 4-digit integers
- begin to find the difference between two sums of money, recognising that the decimal points should line up under each other
- check answers using estimation (with guidance, rounding to nearest thousand / hundred / £ etc as appropriate)

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
```

- **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

```
  12
+ 2.7
 14.7
```

Children should be introduced to short multiplication to solve HTU x U when / if they are ready, and have a solid understanding of grid method process, particularly implications for place value - see Y5 for examples.

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

Remainders:

- 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.

Children should be introduced to short division to solve HTU ÷ U when / if they are ready, and have a solid understanding of chunking process. Short division should be introduced as a compact form of this, not as an entirely new method - see Y5 for examples.

Year 5

Addition

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

$$\begin{array}{r} 53287 \\ +\ 40975 \\ \hline 94262 \\ {\scriptstyle 1\,1\,1\ \ \ \ \ } \end{array} \qquad \begin{array}{r} 34587 \\ +\ 9035 \\ \hline 43622 \\ {\scriptstyle \ 1\ \ 1\,1} \end{array}$$

Using similar methods, children will:

- add several integers with different numbers of digits (up to 6 digits);
- begin to add two or more decimals with the same number of decimal places;
- know that decimal points should line up under each other;
- use estimation and rounding to check answers.

Children should also be taught to add fractions:

- With the same denominator, eg.

$$\frac{1}{7} + \frac{3}{7} = \frac{4}{7}$$

- With denominators that are multiples of the same number, eg.

$$\frac{5}{9} + \frac{1}{3} = \frac{5}{9} + \frac{3}{9} = \frac{8}{9}$$

Subtraction

Decomposition should now be extended to 5-digit numbers and decimals, eg:

$$\begin{array}{r} {\scriptstyle 6\ 1\ \ 6\ 1^{4}\ 1} \\ \not{7}\,3\,\not{7}\,\not{5}\,4 \\ -\ \ 9\,2\,8\,6 \\ \hline 6\,4\,4\,6\,8 \end{array} \qquad \begin{array}{r} {\scriptstyle 6\ 1^{4}\ \ \ 1} \\ \not{7}\,\not{5}.8 \\ -\ 6\,7.9 \\ \hline 7.9 \end{array}$$

Children should:

- be able to subtract numbers with different numbers of digits (up to 6 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;
- use estimation and rounding to check answers.

Children should also be taught to subtract fractions:

- With the same denominator, eg.

$$\frac{9}{13} - \frac{5}{13} = \frac{4}{13}$$

- With denominators that are multiples of the same number, eg.

$$\frac{5}{8} - \frac{7}{12} = \frac{15}{24} - \frac{14}{24} = \frac{1}{24}$$

Multiplication

Children are taught use of the formal method of short multiplication to solve HTU x U problems, eg:

$$\begin{array}{rrrr} & 3 & 4 & 2 \\ \times & & & 7 \\ \hline 2 & 3 & 9 & 4 \\ \hline & {\scriptstyle 2} & {\scriptstyle 1} & \end{array}$$

Progressing onto ThHTU x U using the same method.

Children are then introduced to long multiplication, initially using TU x TU, eg.

24 x 16 =

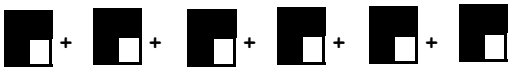
$$\begin{array}{rrrr} & & {\scriptstyle 2} & \\ & & 2 & 4 \\ \times & & 1 & 6 \\ \hline & 2 & 4 & 0 \\ & 1 & 4 & 4 \\ \hline & 3 & 8 & 4 \\ \hline \end{array}$$

This should progress towards ThHTU x TU, eg.

$$\begin{array}{rrrrr} & 1 & 2 & 3 & 4 \\ \times & & & 2 & 3 \\ \hline 2 & 4 & 6 & 8 & 0 \\ & 3 & 7 & 0 & 2 \\ \hline 2 & 8 & 3 & 8 & 2 \\ \hline \end{array}$$

Children should also be taught to multiply proper fractions by units, supported by objects / diagrams where necessary eg:

$\frac{3}{4}$ x 6 =



$= {}^{18}/_{4} = 4\,{}^{2}/_{4} = 4\,{}^{1}/_{2}$

Division

Children are taught the use of the formal method of short division to solve ÷ U problems, beginning with TU ÷ U, eg:

98 ÷ 7 =

$$\begin{array}{r} 1\ 4 \\ 7 \overline{)\ 9\ {}^{2}8} \end{array}$$

= 14

Progressing towards ThHTU ÷ U, eg:

1473 ÷ 4 =

$$\begin{array}{r} 3\ 6\ 8\ \text{r}\ 1 \\ 4 \overline{)\ 1\ 4\ {}^{2}7\ {}^{3}3} \end{array}$$

= 368 r1

Year 6

Addition

Children extend the use of formal column methods to numbers with any number of digits.

$$\begin{array}{r} 7648 \\ +\ 1486 \\ \hline 9134 \\ {\scriptstyle 1\ 1\ 1} \end{array} \qquad \begin{array}{r} 658.4 \\ +\ 58.48 \\ \hline 716.88 \\ {\scriptstyle 1\ 1} \end{array} \qquad \begin{array}{r} 42 \\ 6432 \\ 786 \\ 3 \\ +\ 4681 \\ \hline 11944 \\ {\scriptstyle 1\ 2\ 1} \end{array}$$

Using similar methods, children will

- add several numbers with different numbers of digits;
- add two or more decimals with varying numbers of 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.

Children should be also be taught:

- to check their answers using estimation and rounding, selecting an appropriate degree of accuracy in context;
- to explore the order of operations, understanding the effect of adding brackets to calculations and learning the standard order of operations (brackets, indices & roots, multiplication & division, addition & subtraction)

Children extend their knowledge of addition of fractions by first finding appropriate equivalent fractions:

$$\frac{7}{11} + \frac{2}{3} = \frac{21}{33} + \frac{22}{33} = \frac{43}{33} = 1\frac{10}{33}$$

Subtraction

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

$$\begin{array}{r} 5\overset{6}{\cancel{7}}.\overset{1}{\cancel{2}}\overset{10}{} \\ -\ 12.86 \\ \hline 44.34 \end{array} \qquad \begin{array}{r} 7\overset{6}{0}\overset{9}{0}\overset{9}{0}\overset{1}{} .83 \\ -\ 2978.0 \\ \hline 4022.83 \end{array}$$

Children should:

- be able to subtract numbers with different numbers of digits;
- be able to find the difference between two decimals with different numbers of decimal places;
- know that decimal points should line up under each other;
- understand the use of brackets and order of operations (see left).

Children extend their knowledge of subtraction of fractions by first finding appropriate equivalent fractions:

$$\frac{13}{15} - \frac{5}{6} = \frac{26}{30} - \frac{25}{30} = \frac{1}{30}$$

Multiplication

Children extend their use of both short and long multiplication to include:

- **ThHTU x U, eg. 4346 x 8**
  (using short multiplication)

- **ThHTU x TU, eg. 3974 x 43**
  using long multiplication, eg:

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

- **U.th x U,** particularly in the context of money, eg. £4.92 x 3

Children also extend their understanding of the multiplication of fractions, to include fraction x fraction calculations, writing answers in their simplest form, eg:

$$\frac{7}{10} \times \frac{5}{6} = \frac{7 \times 5}{10 \times 6} = \frac{35}{60} = \frac{7}{12}$$

Children should be also be taught:

- to check their answers using estimation and rounding, selecting an appropriate degree of accuracy in context;
- to explore the order of operations (see left).

Division

Children extend their use of both short and long division to include:

- **ThHTU ÷ U, eg. 8756 ÷ 7**
  using short division, eg:

  8756 ÷ 7 =

		1	2	5	0 r 6
7	8	$^{1}7$	$^{3}5$	6	

  = 368 r6

  = $368\ ^{6}/_{7}$

- **HTU ÷ TU and then ThHTU ÷ TU**
  using long division, eg:

  9472 ÷ 44 =

		2	1	5	r 12
44	$^{8}\not{9}$	$^{1}4$	7	2	
	8	8	0	0	(200 x 44)
		6	7	2	
		4	4	0	(10 x 44)
		2	3	2	
		2	2	0	(5 x 44)
			1	2	

  = 215 r 12 = $215\ ^{12}/_{44}$ = $215\ ^{3}/_{11}$

- **U.th ÷ U,** particularly in the context of money, eg £8.82 ÷ 7

  £8.82 ÷ 7 =

		1 .	2	6
7	8 .	$^{1}8$	$^{4}2$	

  = £1.26

Children learn to interpret remainders, as whole numbers remainders, fractions, or by rounding, depending on the context.

Children should be introduced to the division of proper fractions by whole numbers, eg. $^{1}/_{3} \div 2 = {}^{1}/_{6}$