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Name of policy: Progression in Written Calculations Policy

REVISION HISTORY

	Date
APPROVED BY COMMITTEE	
RATIFIED BY GOVERNING BODY	
NEXT REVIEW	

Head Teacher _____ Date _____

Chair of Governors _____ Date _____

This policy has been created to demonstrate the stages that children will go through in learning how to add, subtract, multiply and divide.

Some children will miss out some stages while others may use additional strategies to consolidate their understanding. Children will not be moved on to the next stage until they are ready and confident to do so.

Children are not expected to reach the later strategies in each section until near the end of key stage 2.

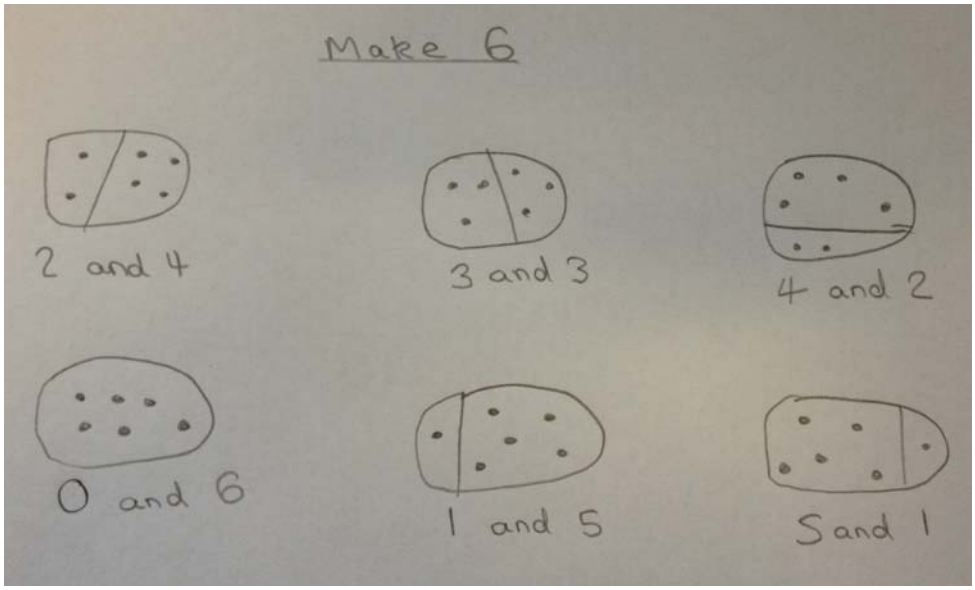
By the end of year 6, children will have a range of calculation methods, mental and written for all four operations. Children will be encouraged to select the most effective method for each calculation.

Children should be encouraged to:-

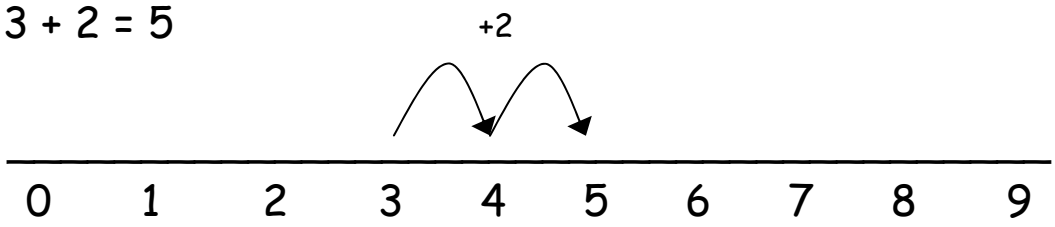
- ✓ Approximate their answers before calculating.
- ✓ Check their answers after calculation using an appropriate strategy.
- ✓ Consider if a mental calculation would be appropriate before using written methods.

Addition

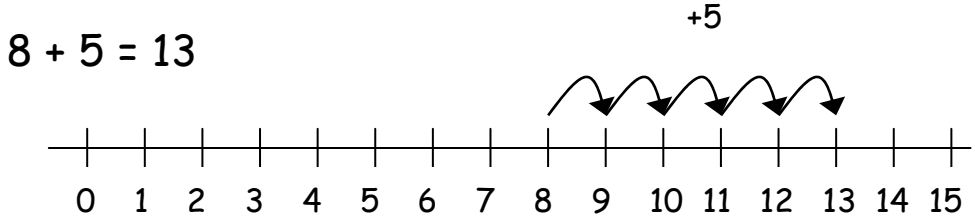
Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures, etc.



They use number lines and **practical resources** to support calculation and teachers *demonstrate* the use of the number line.



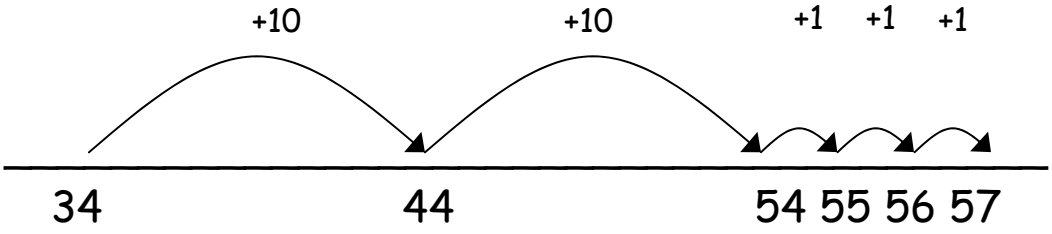
Children then begin to use numbered lines to support their own calculations using a numbered line to count on in ones.



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

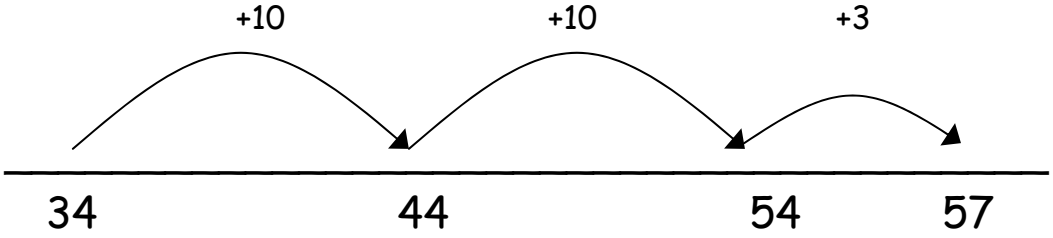
- ✓ First counting on in tens and ones.

34 + 23 = 57 (34 + 10 + 10 + 1 + 1 + 1)



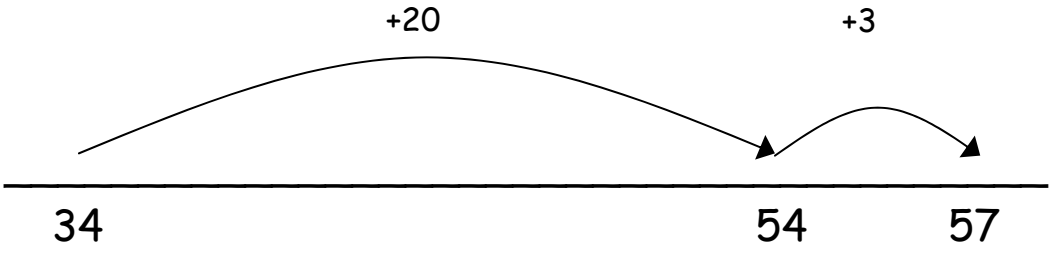
- ✓ Then helping children to become more efficient by adding the units in one jump (by using the known fact 4 + 3 = 7).

34 + 23 = 57 (34 + 10 + 10 + 3)



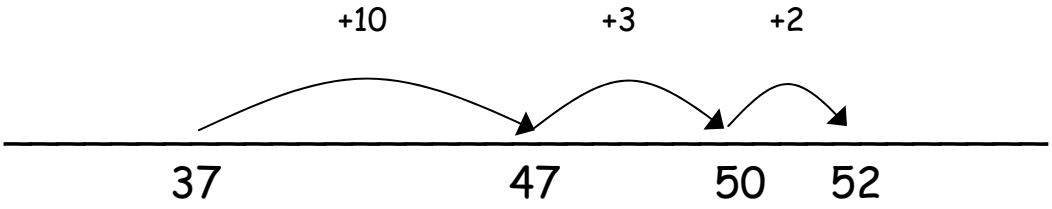
- ✓ Followed by adding the tens in one jump and the units in one jump.

34 + 23 = 57 (34 + 20 + 3)



✓ Bridging through ten can help children become more efficient.

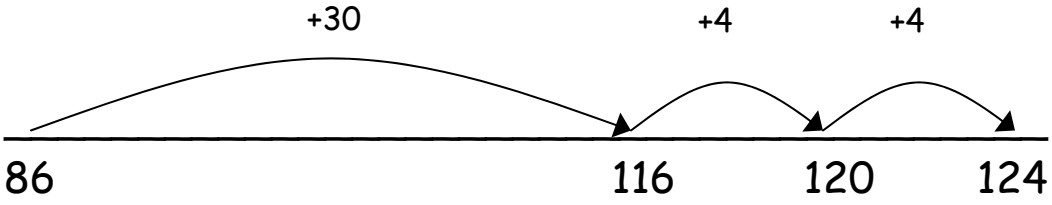
37 + 15 = 52 (37 + 10 + 3 + 2)



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

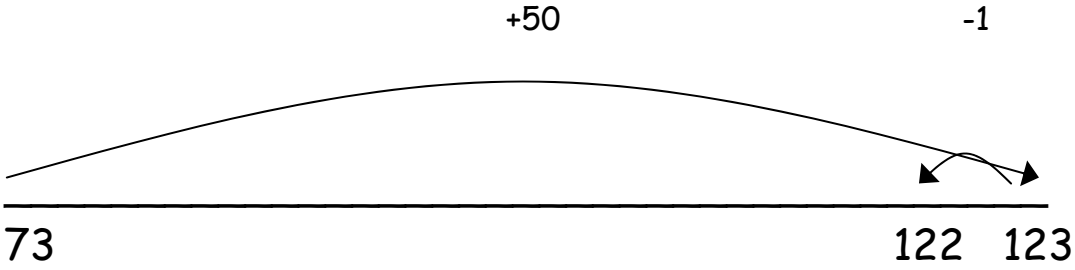
✓ Count on from the largest number irrespective of the order of the calculation.

38 + 86 = 124



✓ Compensation

49 + 73 = 122 (73 + 50 – 1)



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

Moving to adding the least significant digits first in preparation for 'carrying'.

Adding the least significant digits first

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

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

From this, children will begin to carry below the line.

```
  625
+  48
  673
   1
```

```
  367
+  85
  452
  11
```

```
  3587
+  675
  4262
  1 1 1
```

Using similar methods, children will:

- ✓ *add several numbers with different numbers of digits;*
- ✓ *begin to add two or more three-digit sums of money, with or without adjustment from the pence to the pounds;*
- ✓ *know that the decimal points should line up under each other, particularly when adding mixed amounts, e.g. £3.59 + 78p.*
- ✓ *begin to add two or more decimal fractions with up to three digits and the same number of decimal places;*
- ✓ *extend the carrying method to numbers with at least four digits.*

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

$$\begin{array}{r} 7648 \\ +\ 1486 \\ \hline 9134 \\ \scriptstyle \cancel{1}\ \cancel{1}\cancel{1} \end{array} \qquad \begin{array}{r} 6584 \\ +\ 5848 \\ \hline 12432 \\ \scriptstyle \cancel{1}\ \cancel{1}\cancel{1} \end{array} \qquad \begin{array}{r} 42 \\ 6432 \\ 786 \\ +\ 4684 \\ \hline 11944 \\ \scriptstyle \cancel{1}\cancel{2}\cancel{1} \end{array}$$

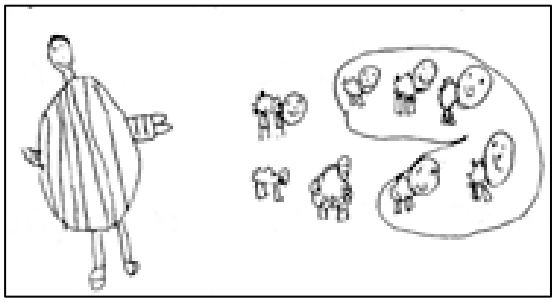
Using similar methods, children will

- ✓ *add several numbers with different numbers of digits;*
- ✓ *begin to add two or more decimal fractions 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 mixed amounts, e.g. 401.2 + 26.85 + 0.71.*

When children are confident with the formal standard written method for addition, they will be encouraged to check their answers using the inverse (subtraction).

Subtraction

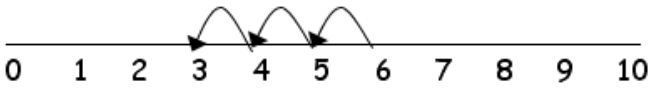
Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures etc.



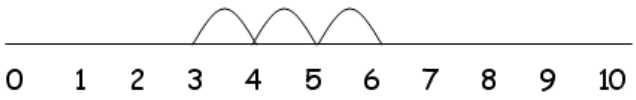
My shepherd looks after 8 sheep.
He has lost 5 sheep so he has 3 left.

They use number lines and **practical resources** to support calculation. Teachers *demonstrate* the use of the number line.

6 – 3 = 3

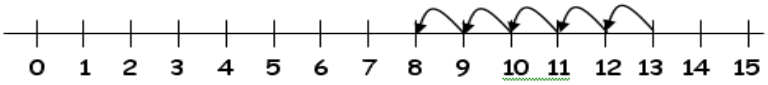


The number line will also be used to show that 6 - 3 means the 'difference between 6 and 3' or 'the difference between 3 and 6' and how many jumps they are apart.



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

13 – 5 = 8

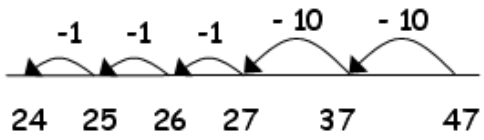


Children will begin to use empty number lines to support calculations.

Counting back

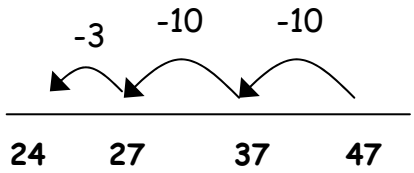
- ✓ First counting back in tens and ones.

47 – 23 = 24



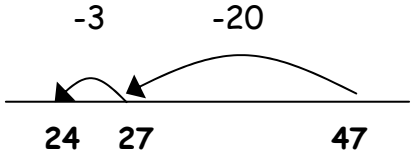
- ✓ Then helping children to become more efficient by subtracting the units in one jump (by using the known fact 7 – 3 = 4).

47 – 23 = 24



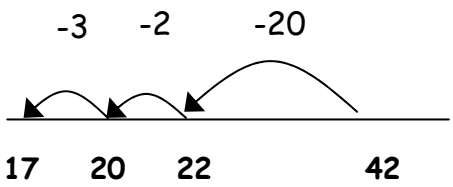
- ✓ Subtracting the tens in one jump and the units in one jump.

47 – 23 = 24



- ✓ Bridging through ten can help children become more efficient.

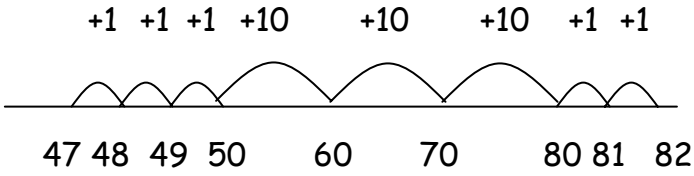
42 – 25 = 17



Counting on

Count on from 47 to 82 in jumps of 10 and jumps of 1.

82 – 47



Help children to become more efficient with counting on by:

- ✓ Adding the units in one jump;
- ✓ Adding the tens in one jump and the units in one jump;
- ✓ Bridging through ten.

Children will continue to use empty number lines with increasingly large numbers.

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

Partitioning and decomposition – This gives further reinforcement and will be a very brief phase for most children.

This process will have been demonstrated using arrow cards to show the partitioning and base 10 materials to show the decomposition of the number.

NOTE: When solving the calculation 89 – 57, children should know that 57 **does NOT EXIST AS AN AMOUNT** it is what you are subtracting from the other number. Therefore, when using base 10 or other materials, children would need to count out only the 89.

$$\begin{array}{rcl} 89 & = & 80 + 9 \\ \underline{-\ 57} & & \underline{50 + 7} \\ & & 30 + 2 = 32 \end{array}$$

Initially, the children will be taught using examples that do not need the children to exchange.

From this the children will begin to exchange.

$$\begin{array}{r} 71 \\ -\ 47 \\ \hline \end{array}$$

Step 1 $70 + 1 - 40 + 7$

Step 2 $60 + 11 - 40 + 7 = 20 + 4 = 24$

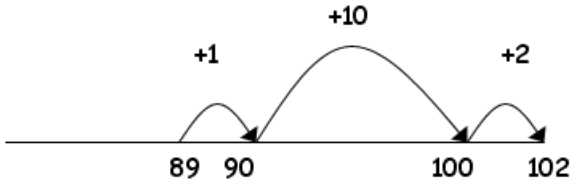
This would be recorded by the children as

$$\begin{array}{l} \overset{60}{\cancel{70}}\ +\ {}^{1}1 \\ -\ 40 + 7 \\ \hline 20 + 4 = 24 \end{array}$$

Children should know that units line up under units, tens under tens, and so on.

Where the numbers involved in the calculation are close together or near to multiples of 10, 100 etc counting on using a number line should be used.

102 – 89 = 13



Partitioning and decomposition – different number of digits

754 =
\- 86

Step 1

700 + 50 + 4
\- 80 + 6

Step 2 *(adjust from Tens to Units)*

700 + 40 + 14
\- 80 + 6

Step 3 *(adjust from Hundreds to Tens)*

600 + 140 + 14
\- 80 + 6
600 + 60 + 8 = 668

This would be recorded by the children as

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

Decomposition

614 1
~~7~~~~1~~5~~4~~4
- 86
668

Using this method children should:

- ✓ *begin to find the difference between two three-digit sums of money, with or without 'adjustment' from the pence to the pounds;*
- ✓ *know that decimal points should line up under each other.*

For example:

£8.95 = 8 + 0.9 + 0.05 leading to
-£4.38 - 4 + 0.3 + 0.08

= 8 + 0.8 + 0.15 *(adjust from Tens to Units)*
- 4 + 0.3 + 0.08
4 + 0.5 + 0.07

= £4.57

1
8.85
- 4.38

Alternatively, children can set the amounts to whole numbers, i.e. 895 – 438 and convert to pounds after the calculation.

Step 1 754 = 700 + 50 + 4
- 286 - 200 + 80 + 6

Step 2 700 + 40 + 14 *(adjust from Tens to Units)*
- 200 + 80 + 6

Step 3 600 + 140 + 14 *(adjust from Hundreds to Tens)*
- 200 + 80 + 6
400 + 60 + 8 = 468

This would be recorded by the children as

$$\begin{array}{rrrrrrl} & 600 & & 140 & & & \\ & \cancel{700} & + & \cancel{50} & + & {}^{1}4 & \\ - & 200 & + & 80 & + & 6 & \\ \hline & 400 & + & 60 & + & 8 & = 468 \end{array}$$

Decomposition

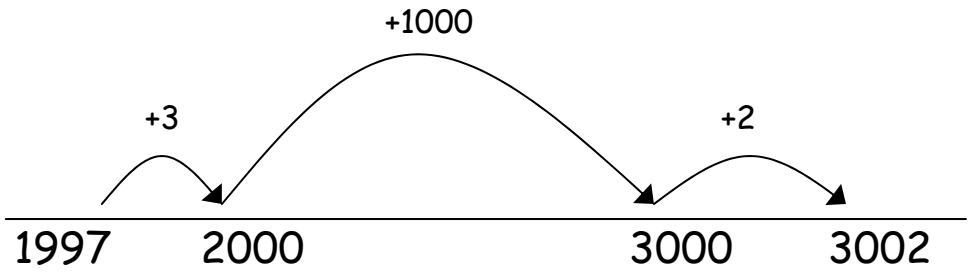
$$\begin{array}{rl} & 614\ 1 \\ & \cancel{7}\cancel{1}54 \\ - & 286 \\ \hline & 468 \end{array} \qquad \begin{array}{rl} & 5\ 13\ 1 \\ & \cancel{6}\cancel{4}67 \\ - & 2684 \\ \hline & 3783 \end{array}$$

Children should:

- ✓ *be able to subtract numbers with different numbers of digits;*
- ✓ *be able to subtract two or more decimal fractions with up to three digits and either one or two decimal places;*
- ✓ *know that decimal points should line up under each other.*

Where the numbers involved in the calculation are close together or near to multiples of 10, 100 etc counting on using a number line should continue to be used.

3002 – 1997 = 1005



When children are confident with the formal standard written method for subtraction, they will be encouraged to check their answers using the inverse (addition).

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.

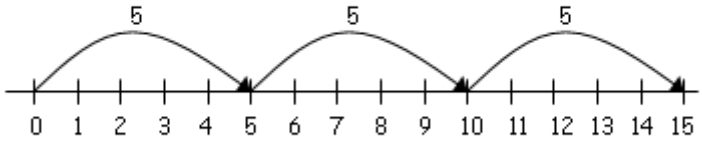
Children will develop their understanding of multiplication and use jottings to support calculation:

✓ **Repeated addition**

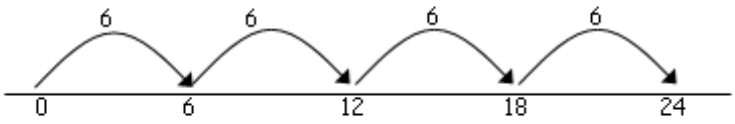
3 times 5 is 5 + 5 + 5 = 15 or 3 lots of 5 or 5 x 3

Repeated addition can be shown easily on a number line:

5 x 3 = 5 + 5 + 5

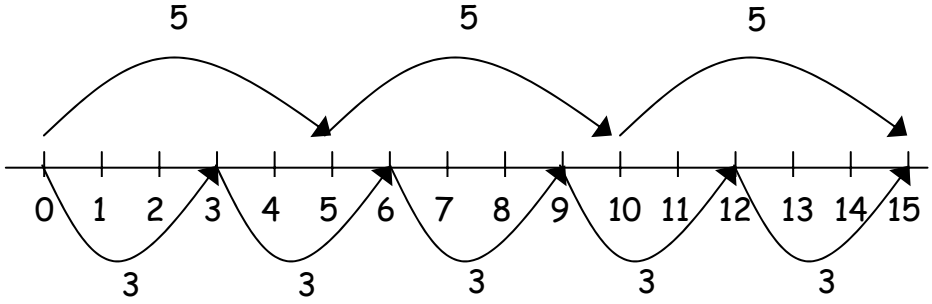


4 times 6 is 6 + 6 + 6 + 6 = 24 or 4 lots of 6 or 6 x 4



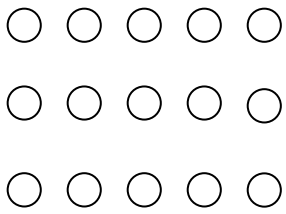
✓ **Commutatively**

Children should know 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 with the development of the grid method.



5 x 3 = 15

3 x 5 = 15

Children will also develop an understanding of:

✓ Using symbols to stand for unknown numbers to complete equations using inverse operations

□ x 5 = 20 3 x △ = 18 □ x O = 32

Children will need lots of opportunity to try these in different formats.

✓ **Partitioning**

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

Children will continue to use arrays where appropriate leading into the grid method of multiplication.

Grid method

TU x U (**Short multiplication** – multiplication by a single digit)

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

HTU x U (**Short multiplication** – multiplication by a single digit)

346 x 9

Children will 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 (**Long multiplication** – multiplication by more than a single digit)

72 x 38

Children will 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 e.g. 4.9 x 3

Children will 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

ThHTU x U **(Short multiplication** – multiplication by a single digit)

4346 x 8

Children will approximate first 4346 x 8 is approximately
4346 x 10 = 43460

x	4000	300	40	6
8	32000	2400	320	48

32000
+ 2400
+ 320
+ 48
34768

HTU x TU (**Long multiplication** – multiplication by more than a single digit)

372 x 24

Children will approximate first 372 x 24 is approximately
400 x 25 =10000

x	300	70	2
20	6000	1400	40
4	1200	280	8

6000
+ 1400
+ 1200
+ 280
+ 40
+ 8
8928
1

U.th x U e.g. 4.92 x 3

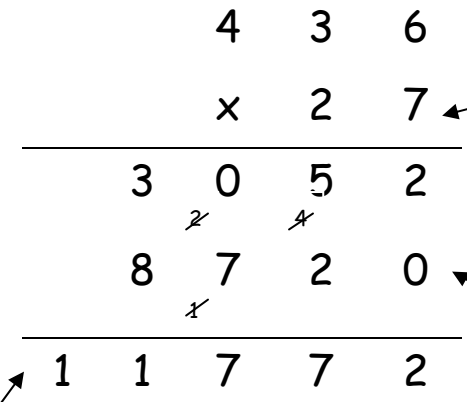
Children will approximate first 4.92 x 3 is approximately 5 x 3 = 15

x	4	0.9	0.02
3	12	2.7	0.06

12
+ 0.7
+ 0.06
12.76

The formal written method for multiplication in Year 6 at Church Hill School

1.) Standard Written Method



1.) Line up the digits with units, tens and hundreds in columns.
2.) Starting with the units, multiply everything by 7.
3.) 6 x 7 = 42. Carry 4 and add this on 3 x 7 = 21 + 4 = 25

4.) Now multiply everything by the tens (20). Before this, add 0 to make answer ten times bigger.
5.) Then continue as before, 6 x 2 = 12, carry the 1.

6.) Finally (starting with the units) add up to the two numbers 3052 + 8720 = 11, 772.

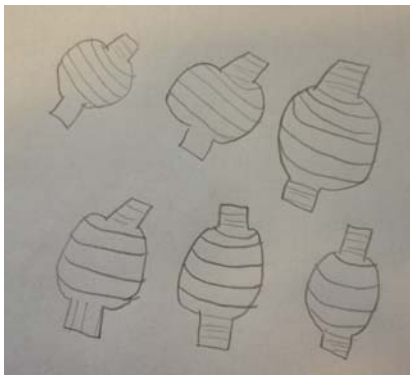
Division

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

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**

12 ÷ 3 = 4

- ✓ **Using symbols to stand for unknown numbers to complete equations using inverse operations**

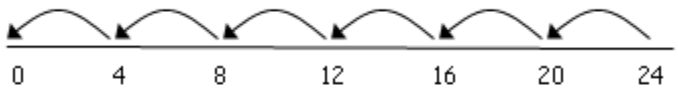
□ ÷ 2 = 4 20 ÷ △ = 4 □ ÷ △ = 4

The emphasis at this stage is on grouping rather than sharing.
Children will continue to use:

- ✓ **Repeated subtraction using a number line**

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

24 ÷ 4 = 6



Children should also move onto calculations involving remainders. This can be done by counting down or up using multiplication facts.

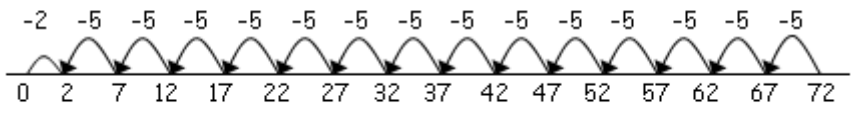
13 ÷ 4 = 3 r 1

- ✓ **Using symbols to stand for unknown numbers to complete equations using inverse operations**

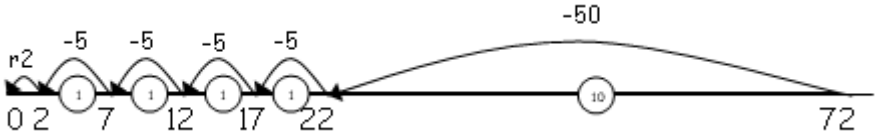
26 ÷ 2 = □ 24 ÷ △ = 12 □ ÷ 10 = 8

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

e.g. 72 ÷ 5



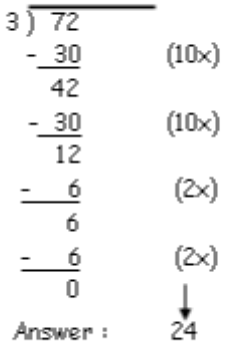
Moving onto:



Then onto the vertical method (chunking):

TU ÷ U Short division

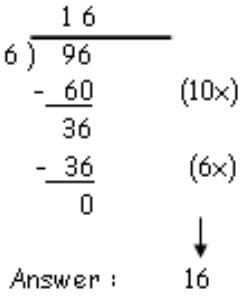
72 ÷ 3



What I know
10 x 3 = 30
1 x 3 = 3
2 x 3 = 6

Leading to subtraction of other multiples.

96 ÷ 6



What I know
10 x 6 = 60
1 x 6 = 6
5 x 6 = 30
6 x 6 = 36

Remainders should be shown as integers, i.e. 14 remainder 2 or 14 r 2.

Children need to be able to decide what to do after division. They should make sensible decisions about rounding up or down after division. For example 62 ÷ 8 is 7 remainder 6, but whether the answer should be rounded up to 8 or rounded down to 7 depends on the context.

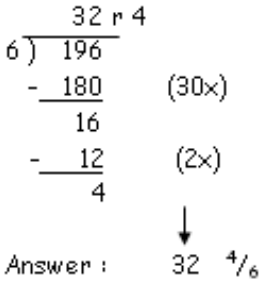
e.g. I have 62p. Sweets are 8p each. How many can I buy?
Answer: 7 (the remaining 6p is not enough to buy another sweet)

Apples are packed into boxes of 8. There are 62 apples. How many boxes are needed?
Answer: 8 (the remaining 6 apples still need to be placed into a box)

Children can start to subtract larger multiples of the divisor, e.g. 30x

Short division HTU ÷ U

196 ÷ 6

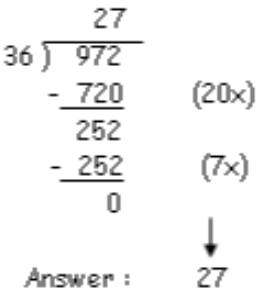


What I know
10 x 6 = 60
20 x 6 = 120
30 x 6 = 180
2 x 6 = 12

Any remainders should be shown as fractions, i.e. 14 remainder $^{2}/_{6}$.

Long division HTU ÷ TU (chunking)

972 ÷ 36

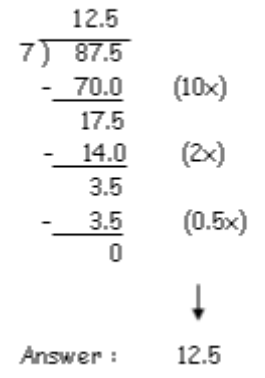


What I know
10 x 36 = 360
20 x 36 = 720
5 x 36 = 180
2 x 36 = 72
7 x 36 = 252

Any remainders should be shown as fractions, i.e. if the children were dividing 32 by 10, the answer should be shown as 3 $^{2}/_{10}$ which could then be written as 3 $^{1}/_{5}$ in it's lowest terms.

Extend to decimals with up to two decimal places. Children should know that decimal points line up under each other.

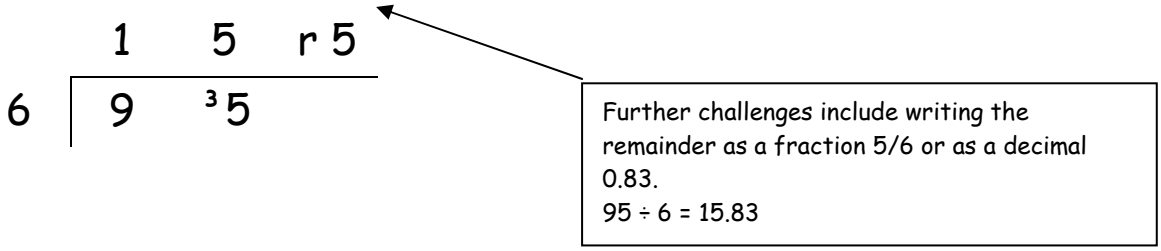
87.5 ÷ 7



What I know
10 x 7 = 70
2 x 7 = 14
5 x 7 = 35
0.5 x 7 = 3.5

There are two written methods used for division in Year 6 at Church Hill School.

We use the Guzinter method (also known as the 'Bus Stop' method) when dividing by a 1 digit number. It gets its name from the language used: "7 goes into 62 eight times remainder 6". This can be a quicker method to use, especially for decimals. It is a difficult method to understand mathematically, and will not be taught until children are familiar with the repeated subtraction model.



As we do not know our times tables for 15, 19, 23 (and so on) we use the chunking method when dividing by a 2 digit number. See page 23.