All Saints' (C of E) Primary School, Maldon
Progression in the four rules of calculation

- This policy is intended to aid all staff in their understanding of the four rules and to provide progression in written calculations.
- It builds on the approach from the National Numeracy Strategy Framework.
- The policy guidance should be referred to when planning, in conjunction with the New National Curriculum.
- Written methods of recording will be used once children have secure mental number knowledge and skills.
- The policy is to give guidance regarding progression.
- Teachers need to be flexible in their approach and recognise that some children will be ready to progress to the next stage, whilst others will need consolidation of previous stages no matter their age or year group. (It is far better for children to be able to operate effectively at any stage, with understanding, than to move them on too quickly). **Children are encouraged, however, under the new curriculum to be using a formal written method by the end of year 6.**
- Children will be encouraged to use their own effective method to perform calculations.

Teaching Points

When approaching a calculation, children should be encouraged to ask themselves the following questions . . . .

- Can I do this in my head?
- Do I know the approximate size of the answer?
- Do I need to use a calculator to work this out?
- If I can't answer it wholly in my head, what do I need to write down in order to help me calculate the answer? (jottings)
- Which written method would be helpful?

Whenever appropriate, children should do a mental calculation. For example which of these would you do mentally?

3002 – 2998 = 9563 – 3771 =

In order to encourage mental calculations strategies, calculations should always be presented to children horizontally so that they can decide how to tackle them. Ensure when using textbooks that questions are presented appropriately and that explanations of methods follow the school policy.

When modelling calculations use language that reflects the size of the numbers involved. (E.g. carry ten rather than carry one).

Overview of Methods

- It is expected that addition/subtraction and multiplication/division be taught alongside each other so that pupils can see the relationship between them.
- Pupils should be taught to estimate their answers first and check calculations with a variety of strategies including the inverse operation.

Further details can also be found in 'Teaching written calculations: Guidance for teachers at KS1 and KS2'

Addition

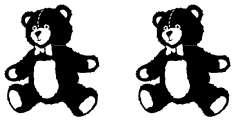
Stage 1

Counting, knowing the order of numbers, lots of practical activities with no written recording.

Combine two groups of objects and begin to record pictorially.

Eg, Jane has 3 bears. She was given 2 more. How many does she have now?

3



2

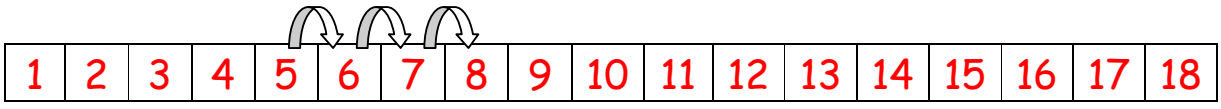
3 + 2 = 5

Children will use a mixture of words and symbols in order to explain to someone else the methods they have used.

Stage 2

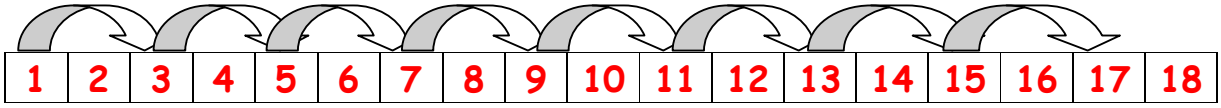
The use of numbered number tracks and lines is very helpful for teaching children the order of numbers and for images of addition and subtraction. It may begin with children physically jumping forwards and backwards along a numbered number track.

E.g. 5 + 3



Children can then use the track for finding patterns.

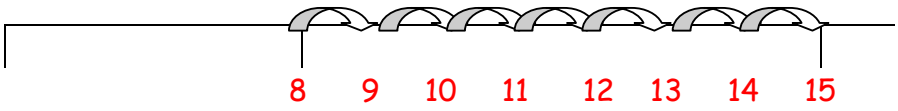
E.g., Mark the numbers you land on when you hop forward in twos from different starting numbers.



Stage 3

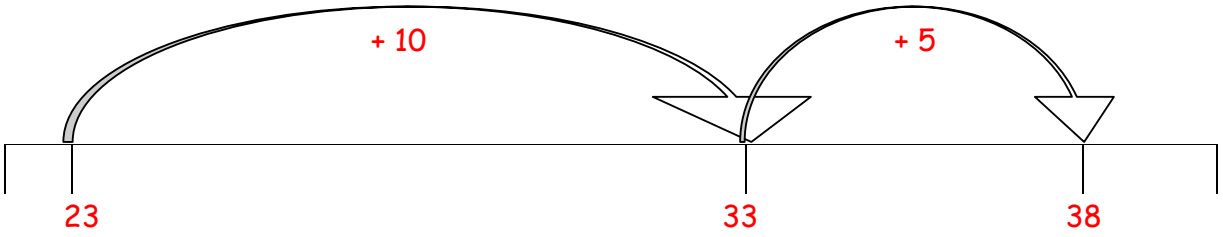
Building on mental methods using an empty number line.

E.g. 8 + 7 = 15

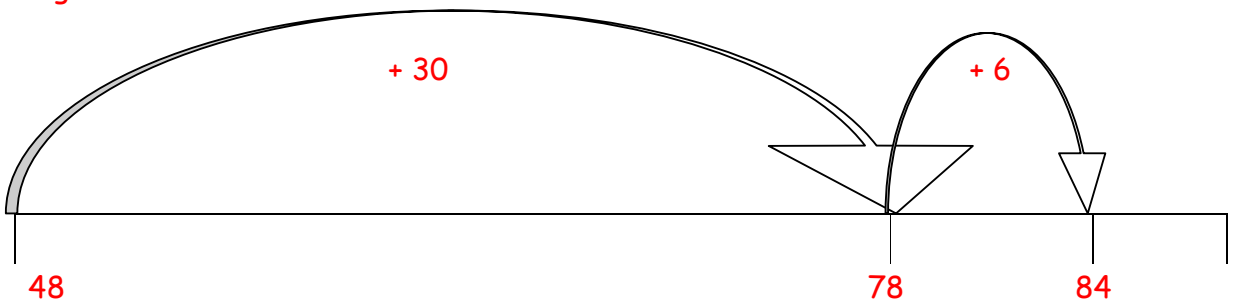


The mental methods that lead to column addition may involve partitioning, e.g. adding the tens and units separately, often starting with the tens.

E.g. 23 + 15 = 38



E.g. 48 + 36 = 84



The empty number line helps to record the steps on the way to calculating the total.

Stage 4

Once children are secure with mentally partitioning numbers, record mental methods using partitioning. Add the tens and then the units to form partial sums and then add these partial sums.

E.g. 43 + 76 = 40 + 70 + 3 + 6
= 40 + 70 + 9
= 110 + 9
= 119

Partitioning both numbers into tens and units mirrors the column method where units are placed under units and tens are placed under tens.

E.g. 43 + 76 = 43 = 40 + 3
+76 = 70 + 6
110 + 9 = 119

Stage 5

Move on to a layout showing the addition of the tens to the tens and the units to the units separately. To find the partial sum children should be taught to add the units digits first.

E.g. 87 + 45 =

87
\+ 45
12 (7 + 5)
120 (80 + 40)
132

Of course this method can be used for adding three digit numbers.

E.g. 438 + 275 =

438
\+ 275
13
100
600
713

This expanded method will lead to the more compact method so that they can understand its structure and efficiency.

Stage 6

In this compact, column method, recording is reduced further. Carry digits are recorded below the line, using the phrases 'carry ten' or 'carry one hundred' not carry one. This method can be applied to numbers with varying numbers of digits.

Eg,	47	258	366
	+76	+ 87	+458
	123	345	824
	11	1 1	1 1

Stage 7 – Using and applying addition methods in a problem solving context and to decimal numbers. (EXTENSION)

E.g. Find the total weight of 5 adults weighing 72kg, 57.4kg, 89.75kg, 72.9kg and 89.4kg to determine if they can all get in a lift with a total weight restriction of 400kg.

```
  72.00
  57.40
  89.75
  72.90
+89.40
 381.45
  32
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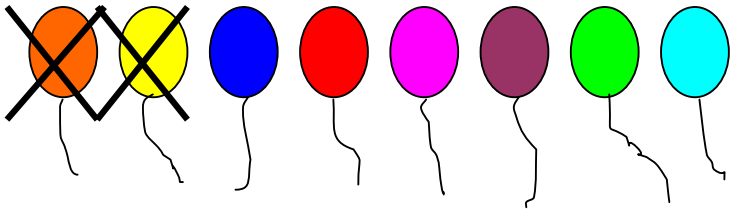
Subtraction

Stage 1

Counting backwards, knowing the order of numbers, lots of practical activities with no written recording.

Children need practical activities of taking away, that is finding how many are left from a collection of objects when some are removed.

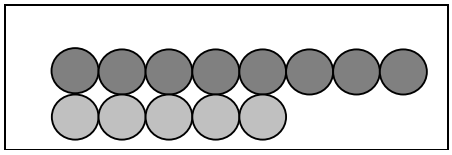
E.g. There were 8 balloons. Two popped. How many balloons are left?



8 – 2 = 6

Children also need practical activities around 'finding the difference', which involves making a comparison between the numbers in two groups of objects. They need to recognise that this is another example of subtraction.

E.g. How many more biscuits does Sally have than you? (The biscuits are represented by counters).



'Sally has 3 more than me'.

A mixture of words and symbols will be used by children in order to explain to someone else the methods that they have used. Children will use a variety of ways of recording subtraction, reflecting the mental methods used.

Stage 2

The use of numbered number tracks and lines is very helpful for teaching children the order of numbers and for images of addition and subtraction. It may begin with children physically jumping forwards and backwards along a numbered number track.

Eg, There are 20 children in our class. Three are away today. How many are here?

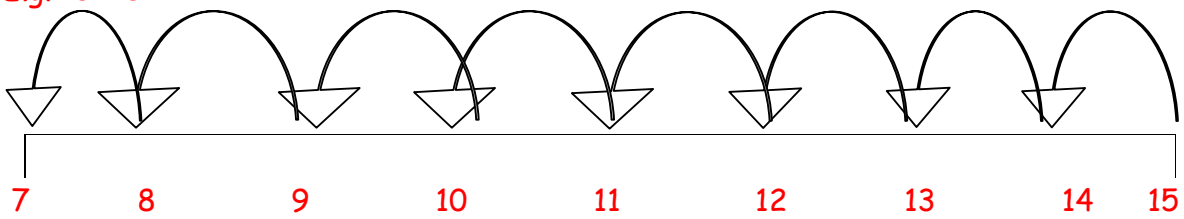
20 – 3 = 17

Stage 3

The empty number line helps to record or explain the steps in mental subtraction. Steps in subtraction can be recorded on a number line. The steps often bridge through a multiple of 10

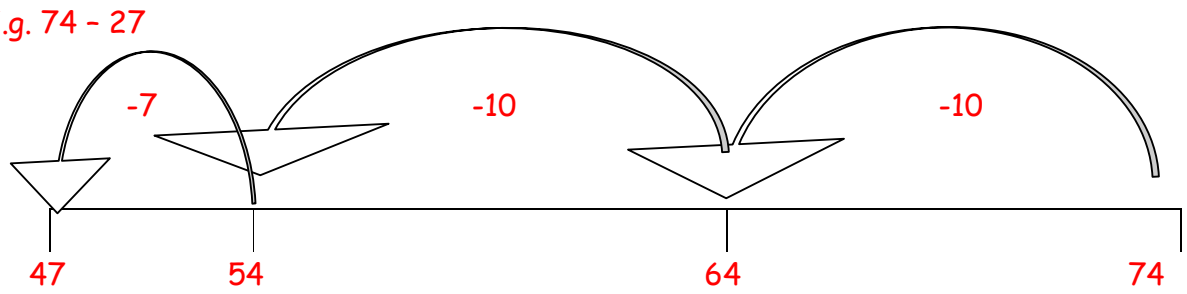
(i) Counting back in units

E.g. 15 – 8



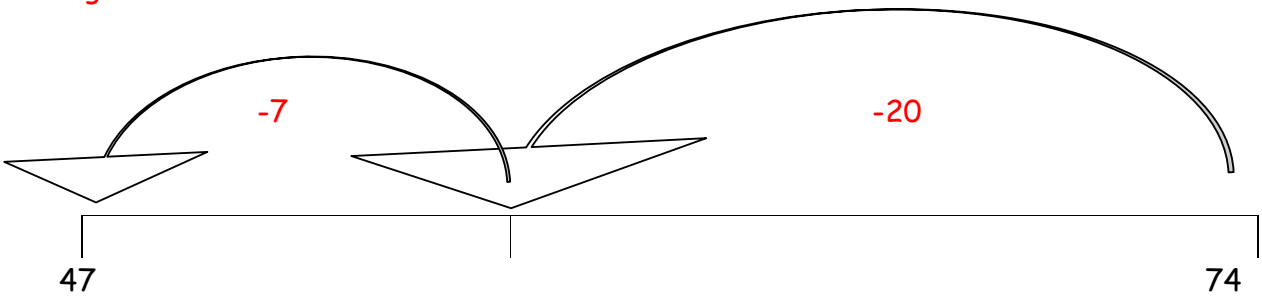
(ii) Counting back by partitioning the number into tens and units

E.g. 74 – 27



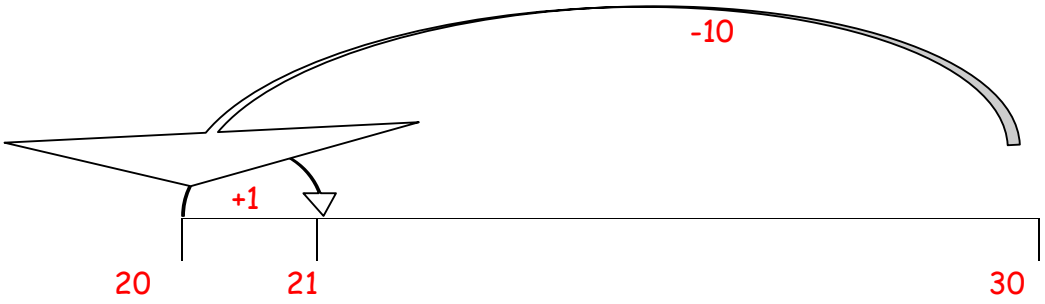
(iii) With practice children will need to record less information

E.g. 74 – 27 = 74 – 20 – 7 = 54 – 7 =47



(iv) Children may use efficient mental methods to inform their written methods, e.g. adjusting

E.g. 30 – 9

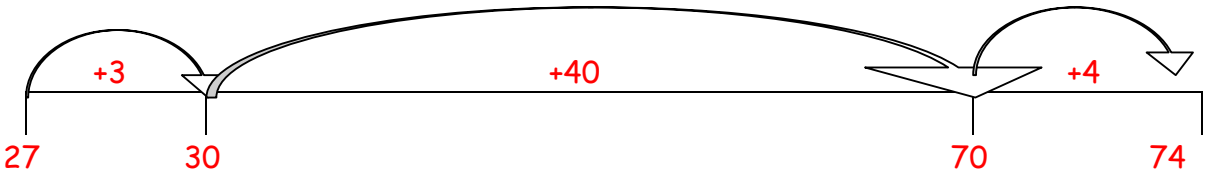


Some children prefer to count on from the smaller to the larger number to find the difference. Particularly mentally this may be a more efficient method. For example consider whether you would count up or back when solving these calculations.

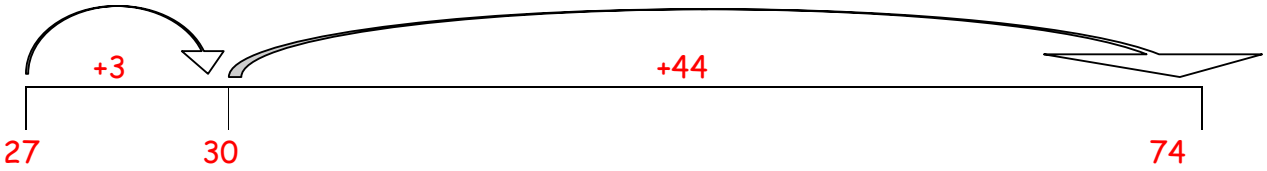
57 – 12 86 – 77 43 – 28

Each of the methods explained in points (i) – (iv) can be applied to this counting on method as explained in these examples:

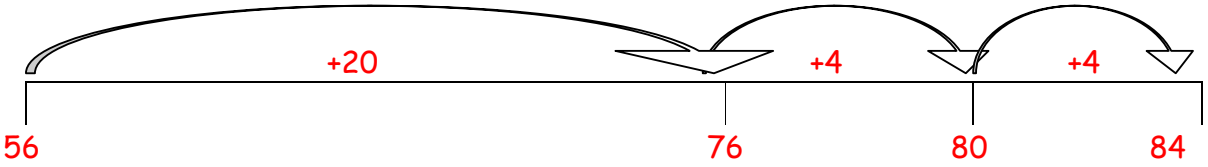
E.g. 74 – 27



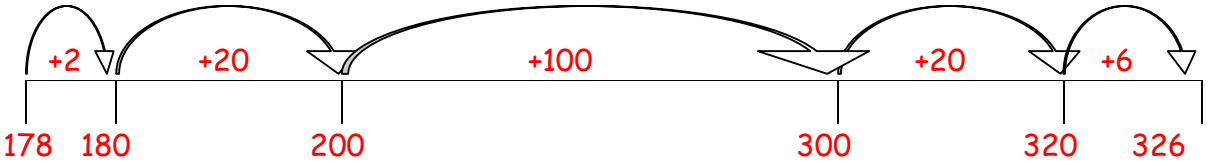
E.g. 74 – 27



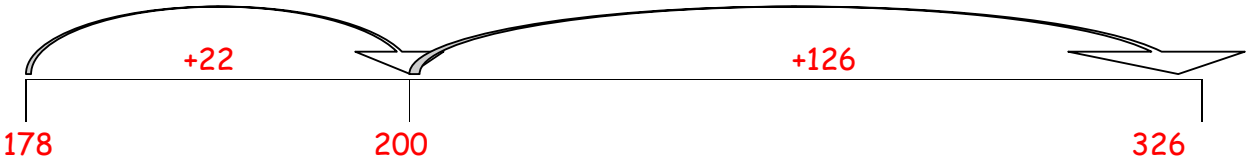
E.g. 84 – 56



E.g. 326 – 178



E.g. 326 –178



Stage 4

Building on the number line, children partition and subtract mentally.
First children should be given sums where no decomposition is required.

E.g., 47 – 36 = 47 – (30 + 6) = 47 – 30 = 17 - 6 = 11

Then children can cross the tens boundary

E.g., 75 – 47 = 75 – (40 + 7) = 75 – 40 = 35 – 7 = 28

Stage 5

Stage 5 is the expanded layout, which leads to the column method. Partitioning the numbers into tens and units and writing one under the other, mirrors the column method where tens are placed under tens and units under units. This method parallels the column addition method.

E.g. 74 – 23 = 70 + 4 = 70 + 4
-20 + 3 -20 + 3
40 + 1

This method can be applied to decomposition

E.g. 74 - 27 = 70 + 4 = 60 14
70 + 4
-20 + 7 - 20 + 7
40 + 7

This can be applied to 3 or 4 digit numbers.

E.g. 563 – 271 = 500 + 60 + 3 = 400 160
500 + 60 + 3
-200 + 70 + 1 - 200 + 70 + 1
200 + 90 + 2

This method is written in the initial stages, but children should be encouraged to tackle this mentally.

Stage 6

This method leads to a more compact method.

E.g. 74 - 27 = 6 14
74
-27
47

This can be applied to 3 or 4 digit numbers.

E.g. 563 - 271 = 4 15
563
-271
292

Stage 7 – Using and applying subtraction methods in a problem solving context and to decimal numbers. (EXTENSION)

E.g. Find the difference in weight of 2 adults weighing 57.8kg, and 89.75kg.

$$\begin{array}{r} {\scriptstyle 8\ 17} \\ 8\not{9}.75 \\ -57.80 \\ \hline 31.95 \end{array}$$

Multiplication

Stage 1

It is expected that there will be lots of practical activities to support children's growing awareness and understanding of multiplication.
Children can complete practical activities involving grouping objects. Rhymes and stories can be used that involve counting in different intervals.

Use apparatus to sort objects into groups.

E.g. Sort six compare bears into 2 groups. How many in each group?

2 lots of 3
2 groups of 3
3 x 2

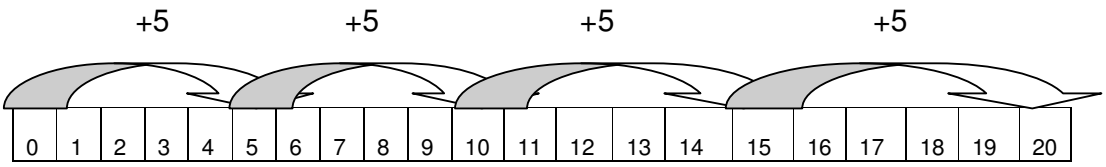
A mixture of pictures, words and symbols will be used by children in order to explain to someone else the methods that they have used.

Stage 2

Children will begin to recognise multiplication as repeated addition.

E.g. What is the value of 4 five-pence coins?

5 + 5 + 5 + 5
4 groups of 5
5 x 4



Stage 3

This method of mental multiplication using partitioning allows the tens and units to be multiplied separately to form partial products and these are then added to find the total product.

E.g. 43 x 4 = 40 + 3

↓ ↓

160 12 = 172

E.g. 43 x 4 = (40 + 3) x 4

(40 x 4) + (3 x4)

160 + 12 = 172

To be able to use written methods of multiplication successfully it is important children's mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for multiplication. For example;

* recalling multiplication facts.
* multiplying by 10 and 100.
* partitioning numbers into multiples of hundreds, tens and one.
* add two or more single digit numbers mentally.
* add multiplies of 10 or 100.
* add combinations of whole numbers using the column method.

Stage 4

The grid method is the main method taught and found to be the method staff feel produces the least amount of errors.

E.g. 38 x 7 =

x	7
30	210
8	56
	266

E.g. 56 x 27 =

x	20	7	
50	1000	350	1350
6	120	42	162
			1512

Stage 5

Extend the grid method to HTU x TU

E.g. 286 x 29

x	20	9	
200	4000	1800	5800
80	1600	720	2320
6	120	54	174
			8294

Stage 6

The grid method can be extended to bigger numbers and decimals
This can be presented vertically however the grid method is the most straightforward and efficient way of multiplying and would allow children to tackle any multiplication problem.

```
  56
x 27
  42    (6 x 7    =   42)
 350    (50 x 7   =  350)
 120    (6 x 20   =  120)
1000    (50 x 20  = 1000)
1512
 1
```

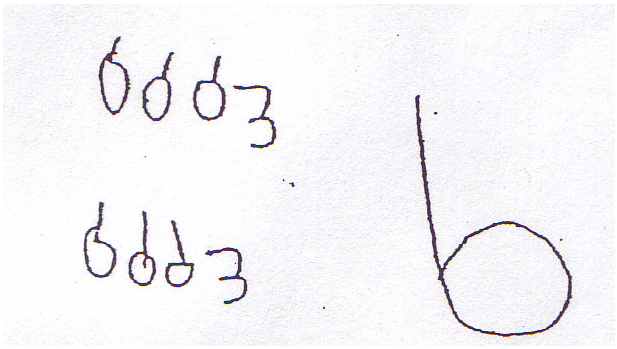
This moves on to …

```
  56
x 27
 392
1120
1512
 1
```

Division

Stage 1

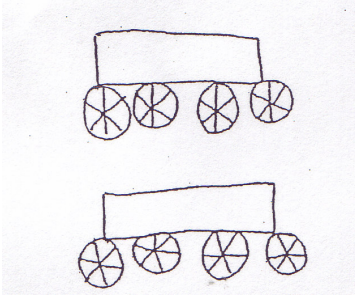
Young children will be familiar with the language of sharing and understand that six shared equally among three people means everyone has two each and that if they were shared between two people, both would have three.



Stage 2

Children can draw pictures to explain to someone else how they have solved a simple division problem.

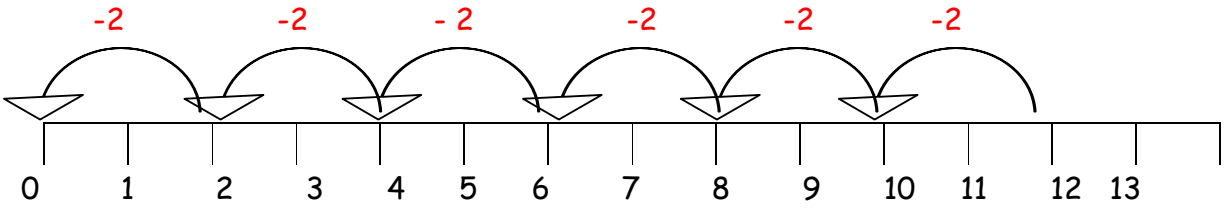
E.g. How many cars can you make with 4 wheels each if you have eight wheels?



Stage 3

Children will begin to recognise division as repeated subtraction.

E.g. 12 ÷2



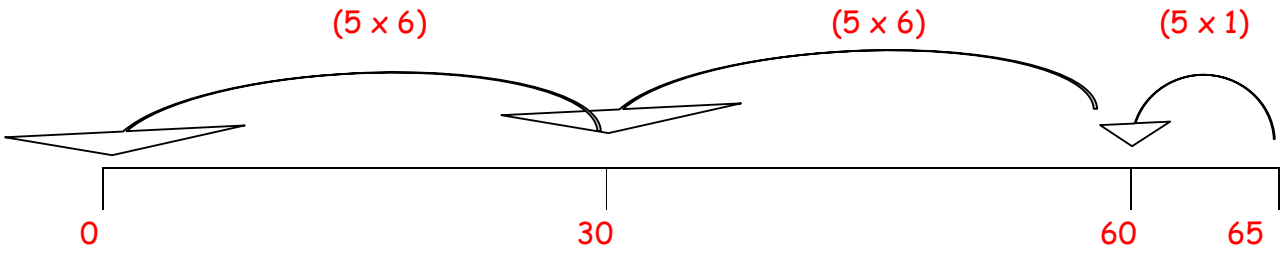
E.g. 24 ÷ 4 = 24 – 4 = 20
20 – 4 = 16
16 – 4 = 12
12 – 4 = 8
8 - 4 = 4
4 - 4 = 0 = 6 (lots of 4 subtracted)

Once mastered both stages 2 and 3 can be repeated using calculations that involve remainders.

Stage 4

Repeated subtraction on a number line can be used with larger numbers by taking away more than one group at a time.

E.g. 65 ÷ 5 =



Stage 5

Chunking – Using tables facts to help. The chunking method is the method which staff feel produces the fewest amount of errors.

E.g. 128 ÷ 4

128
- 40 (4 x 10)
88
- 40 (4 x 10)
48
- 40 (4 x 10)
8
- 8 (4 x 2) = 10 + 10 + 10 + 2 = 32
0

Examples should also include calculations that leave remainders.

E.g. 97 ÷ 3

97
-60 (3 x 20)
37
- 36 (3 x 12) =20 + 12 = 32
1

97 ÷ 3 = 32 remainder 1

Stage 6

In readiness for year 7, more able year six children will be introduced to standard written methods of long division, initially using the chunking strategy, but may look at other written methods (see E.g. 2).

E.g. 972 ÷ 36

36 | 972
- 720 (36 x 20)
252
- 252 (36 x 7) = 20 + 7 = 27
0

972 ÷ 36 = 27

At this stage remainders may now be divided further leading to a decimal answer.

E.g. 2 634 ÷ 5

126 .8
5 | 634.0