Calculations Policy

Second edition March 2016

This policy has been written in line with the new national curriculum of 2014. It aims to provide guidance so that all children will be able to do the formal written methods. The stages leading to each formal method are given in this policy. Teachers and staff should use their judgements as to where each child is currently working and begin developing their understanding from that stage.

STAGES OF ADDITION

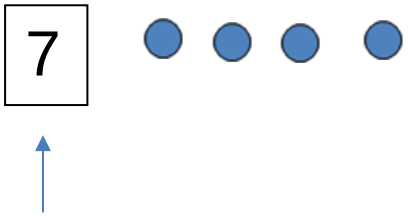
STAGE 1

Combine 2 sets of objects

12

Issue:
Tend to count one set, count the other and then count all.

Adding on to a set

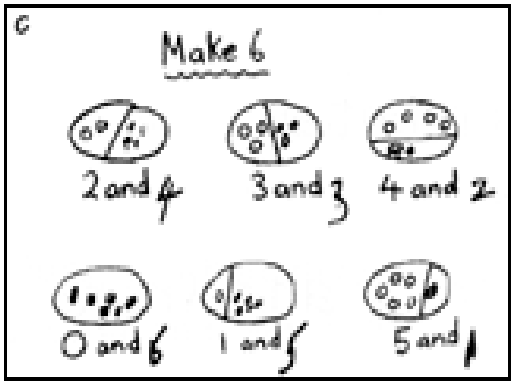


12

This number already known by the child, then count on 4.

Issue:
Requires fluency with counting from any number.

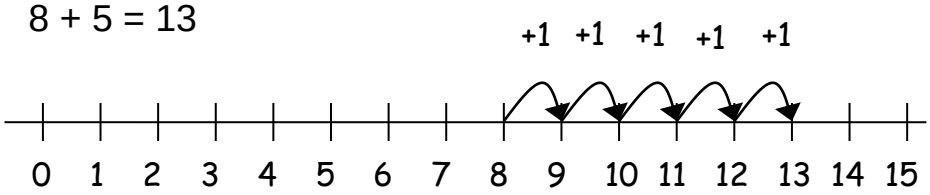
Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures, etc.



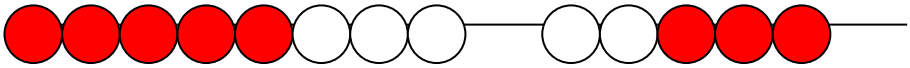
STAGE 2

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

8 + 5 = 13



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

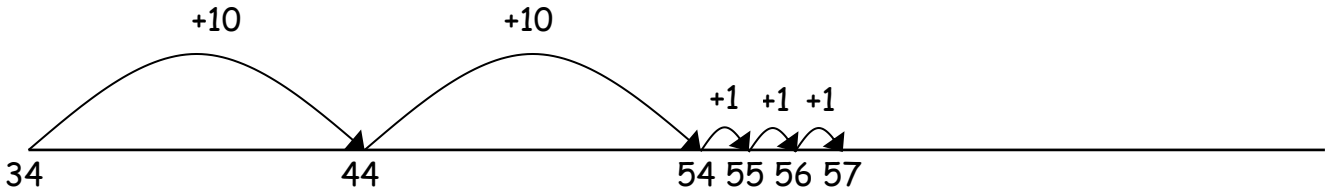


STAGE 3

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

First counting on in tens and ones.

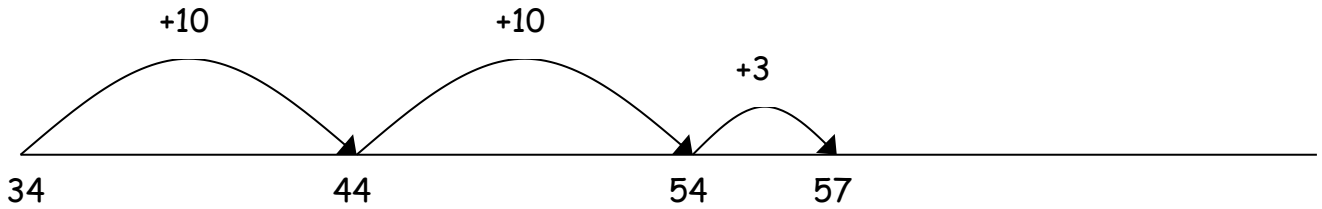
34 + 23 = 57



STAGE 4

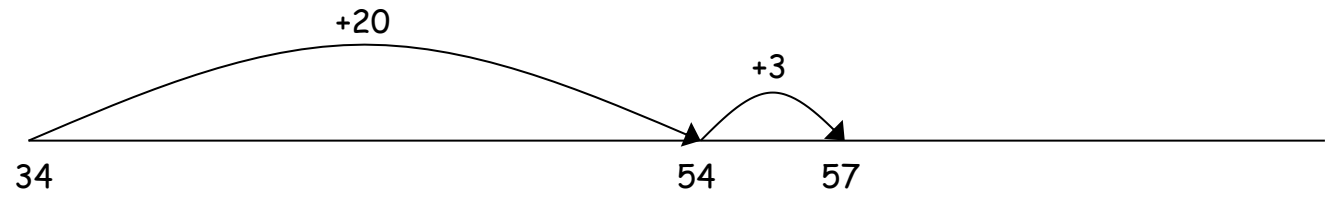
Then helping children to become more efficient by adding the units in one jump (by using the known fact 4 + 3 = 7).

34 + 23 = 57



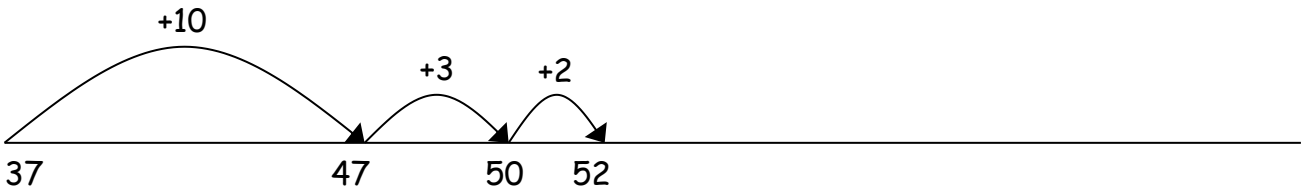
Followed by adding the tens in one jump and the units in one jump.

34 + 23 = 57



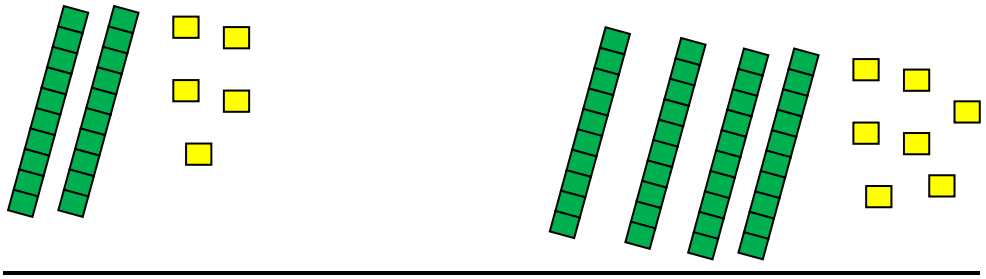
Bridging through ten can help children become more efficient.

37 + 15 = 52



STAGE 5 Alongside this, use base ten equipment or similar

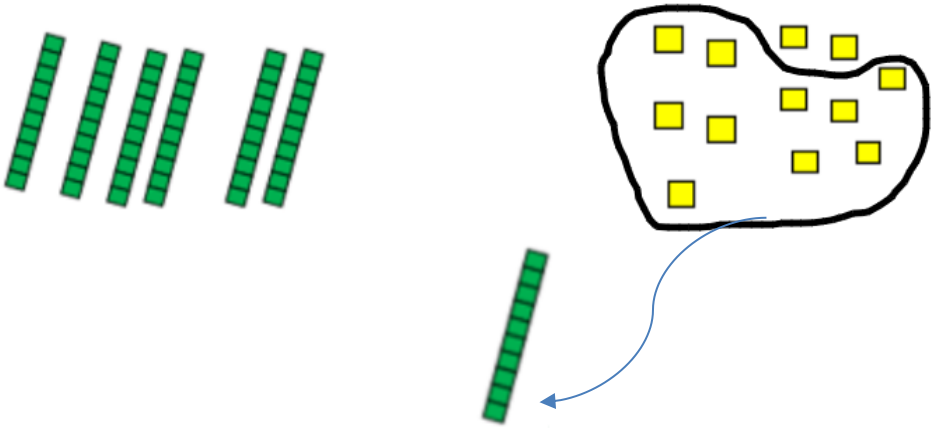
(25 + 47)



Leads to

(60 + 12)

(group ten ones together)

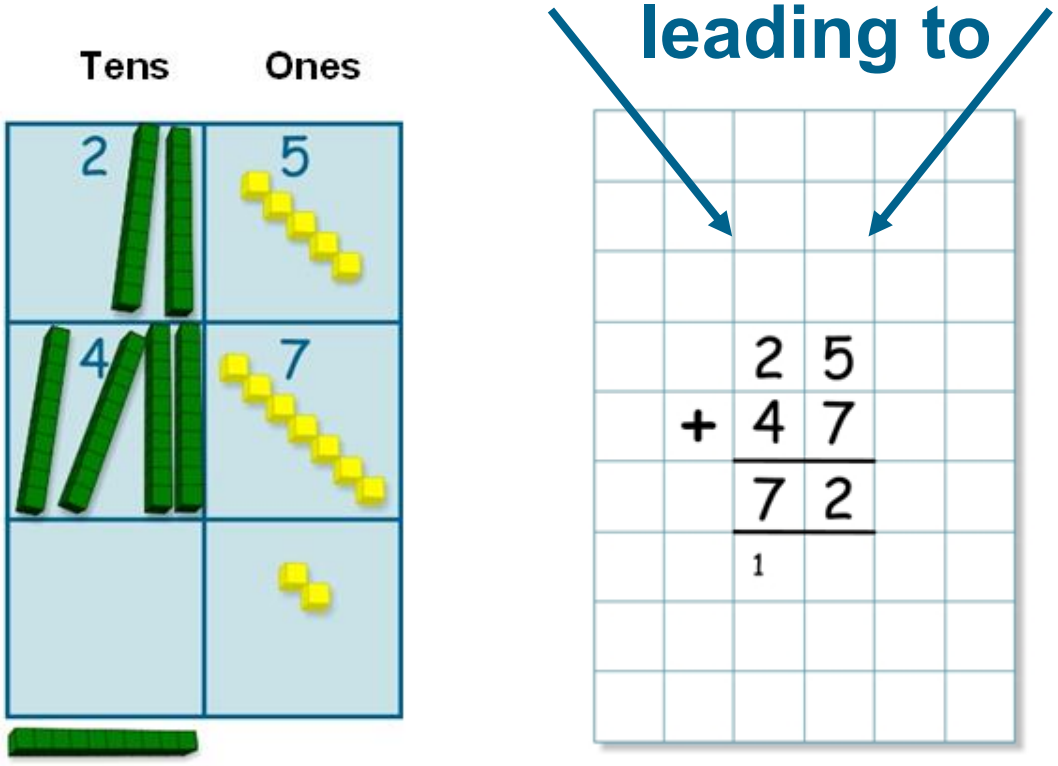


= 72

Which becomes partitioning

25 + 37 =

20 + 5
30 + 7
50 + 12 =62



STAGE 6 - Continuing with numberlines – this will help mental strategies

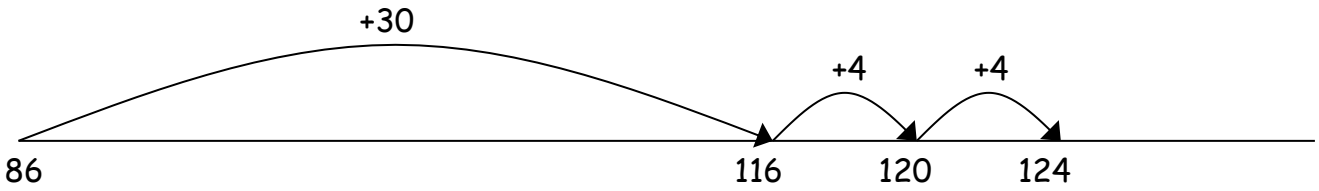
Adding ten and then compensating when adding 9, 11, 19, 21 etc

36 + 9 = 45

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

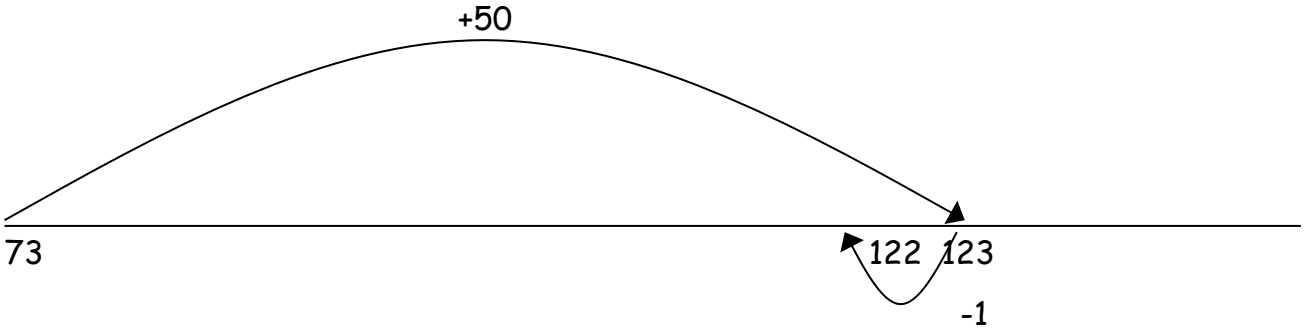
Count on from the largest number irrespective of the order of the calculation.

38 + 86 = 124



Compensation

49 + 73 = 122



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

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 or subtracting mixed amounts, e.g. £3.59 + 78p*.

STAGE 7 Expanded Partitioning

When beginning to add larger numbers the children should be taught the partitioning method. This may help children who are not ready for the formal method.

462 + 215 =

400 + 60 + 2
200 + 10 + 5

600 + 70 + 7 = 677

STAGE 8 THE FORMAL WRITTEN METHOD

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

```
  587
+ 475
 1062
  1 1
```

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

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

```
  7648
+ 1486
 9134
 1 1 1
```

```
  6584
+ 5848
 12432
 1 1 1
```

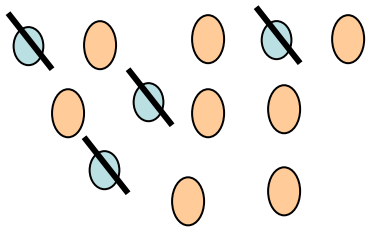
```
   42
 6432
  786
    3
+ 4681
 11944
 1 2 1
```

Using similar methods, children will

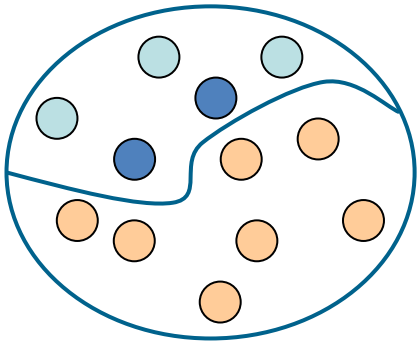
- ✓ *add several numbers with different numbers of digits;*
- ✓ *begin to add two or more decimal fractions with up to four digits and either one or two decimal places;*
- ✓ *know that decimal points should line up under each other, particularly when adding or subtracting mixed amounts, e.g. 401.2 +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

SUBTRACTION

Stage 1



12-4 = 8



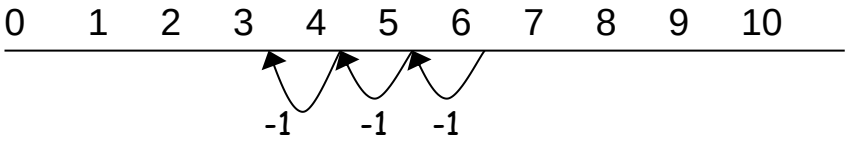
Issue:
Helps to see the related calculations; 5+7=12, 7+5=12, 12-7 = 5 and 12-5=7 as all in the same diagram

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.

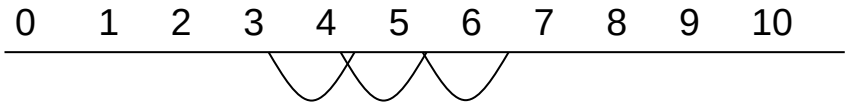
They use number lines and practical resources to support calculation.

STAGE 2 - NUMBER LINES

6 – 3 = 3

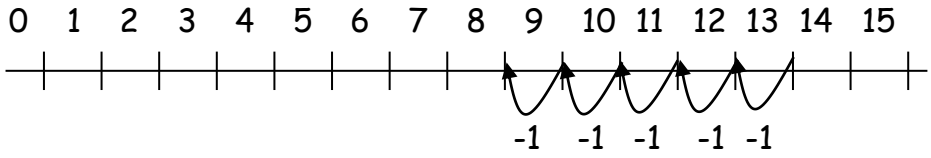


The number line should also be used to show that 6 - 3 means the 'difference between 6 and 3' or 'the difference between 3 and 6' and how many jumps they are apart.



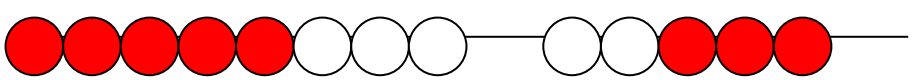
Children then begin to use numbered lines to support their own calculations - using a numbered line to count back in ones.

13 – 5 = 8



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

13 – 5 = 8

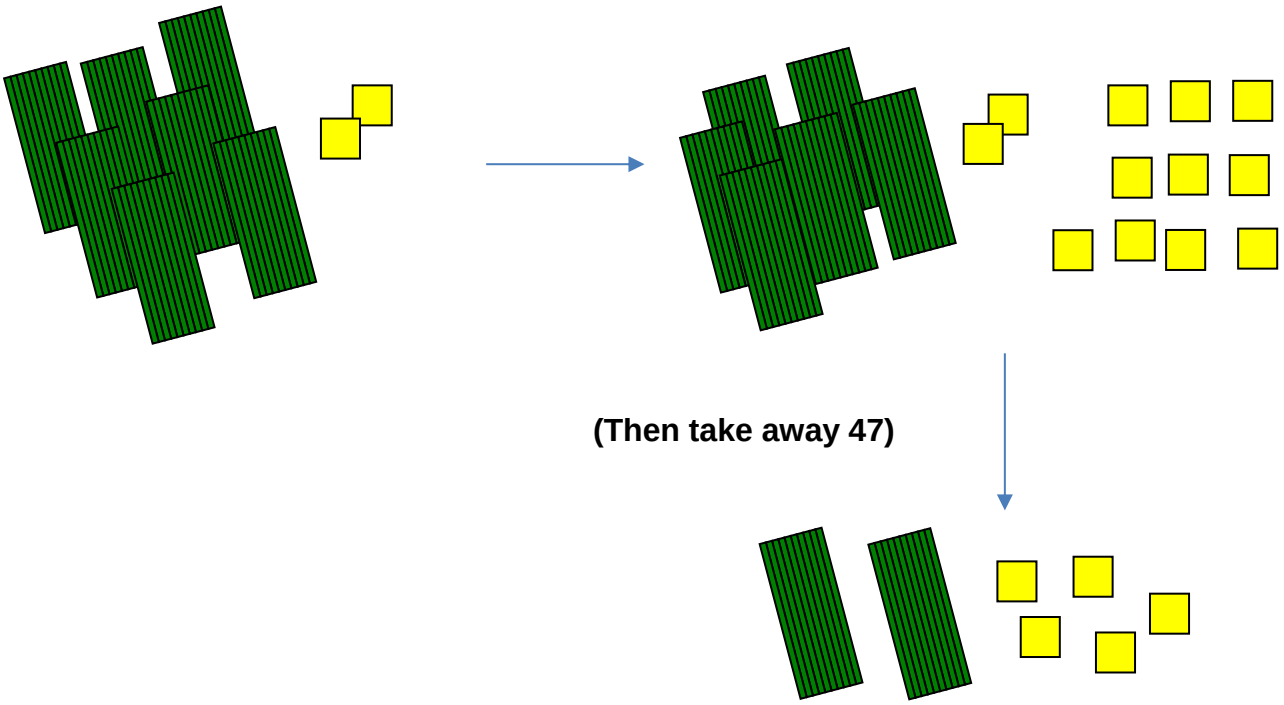


Children will begin to use empty number lines to support calculations.

STAGE 3 – Using tens knowledge

72 – 47

(You cannot subtract 7 from 2 so exchange a ten for ten ones)



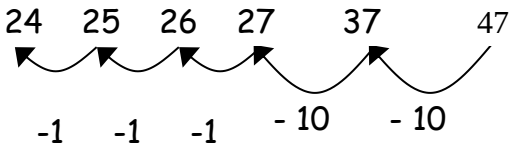
(Then take away 47)

= 25

STAGE 4 - Counting back

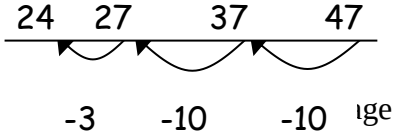
First counting back in tens and ones.

47 – 23 = 24



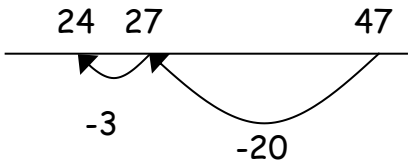
Then helping children to become more efficient by subtracting the units in one jump (by using the known fact 7 – 3 = 4).

47 – 23 = 24



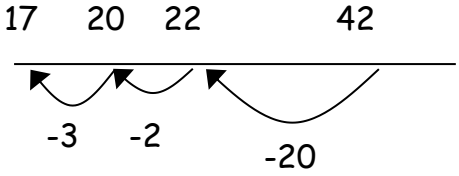
Subtracting the tens in one jump and the units in one jump.

47 – 23 = 24



Bridging through ten can help children become more efficient.

42 – 25 = 17



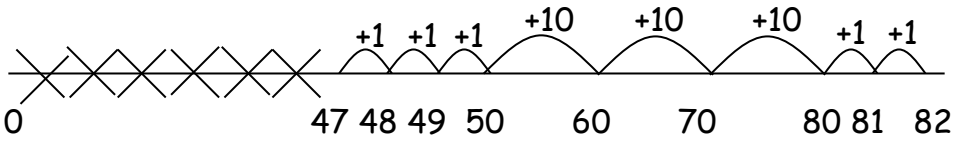
STAGE 5 - Counting on (possible strategy for children who do not understand counting back.

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.

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

The number line should still show 0 so children can cross out the section from 0 to the smallest number. They then associate this method with 'taking away'.

82 - 47



Help children to become more efficient with counting on by:

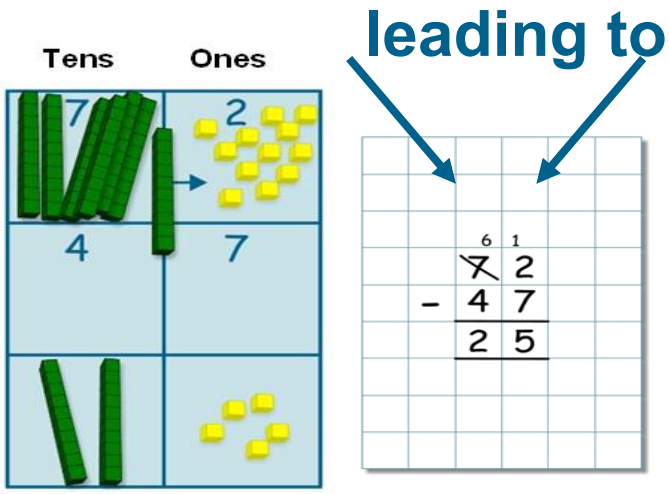
- ✓ Subtracting the units in one jump;
- ✓ Subtracting the tens in one jump and the units in one jump;
- ✓ Bridging through ten.

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.

STAGE 6 - Partitioning and decomposition

This process should be demonstrated using arrow cards to show the partitioning and base 10 materials to show the decomposition of the number.



The method below can be demonstrated by the teacher as means of introduction;

```
  89    =    80  +  9
- 57         50  +  7
             30  +  2  = 32
```

The children should understand the + sign is there to show the partition and that it is a subtraction question overall.

Children would write

```
  89
- 57
  32
```

To introduce decomposition, this could be used as a demonstration method by the teacher

```
Step 1      70  +  1
          - 40  +  6

Step 2      60  +  11
          - 40  +  6
            20  +  5   =  25
```

The calculation should be read as e.g. take 6 from 1.

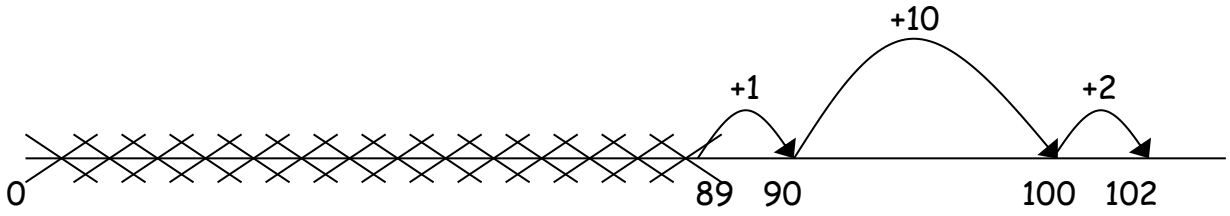
This would be recorded by the teacher as

```
    60
    70  +  11
- 40  +  6
  20  +  5  = 25
```

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

Where the numbers are 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



Children move on to subtracting TU from HTU, the partitioning method can be demonstrated if required.

754 =
- 86

Step 1 700 + 50 + 4
- 80 + 6

Step 2 700 + 40 + 14 *(adjust from T to U)*
- 80 + 6

Step 3 600 + 140 + 14 *(adjust from H to T)*
- 80 + 6
600 + 60 + 8 = 668

This would be recorded by the children as decomposition

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

Including decimal numbers - for example:

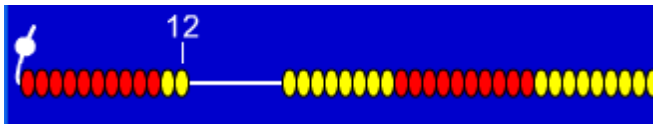
$$\begin{array}{r} {\scriptstyle 7\ 1} \\ 8.\not{8}5 \\ -\ 4.38 \\ \hline \end{array}$$

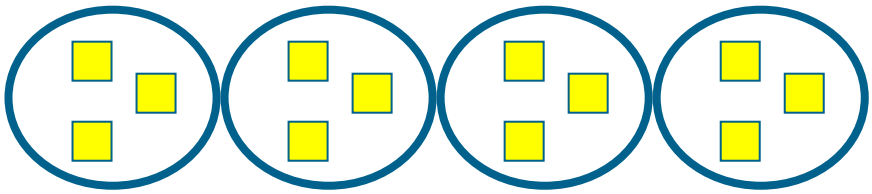
Children should:

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

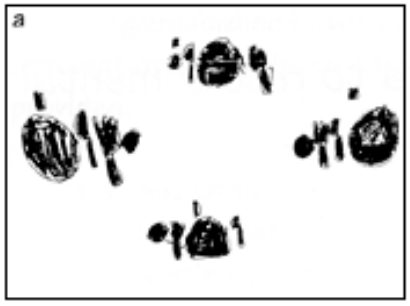
STAGE 1

Children will experience grouping objects equally 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.





Lots of the same thing



STAGE 2

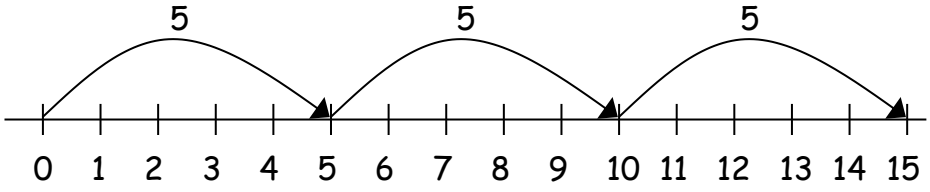
Children will develop their understanding of multiplication and use jottings to support calculation:

✓ **Repeated addition**

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

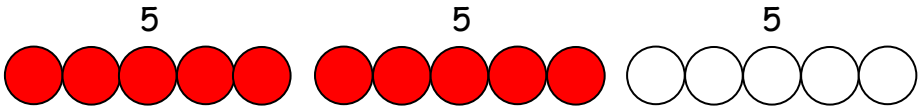
Repeated addition can be shown easily on a number line:

5 x 3 = 5 + 5 + 5



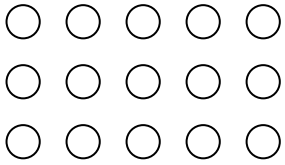
and on a bead bar:

5 x 3 = 5 + 5 + 5



STAGE 3 – ARRAYS – TAUGHT THROUGHOUT THE PROCESS

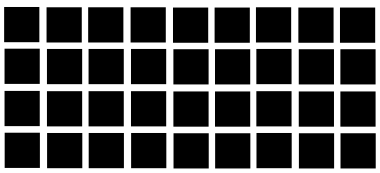
Children should be able to model a multiplication calculation using an array. This knowledge will support with the development of the formal written method.



3 x 5 = 15

5 x 3 = 15

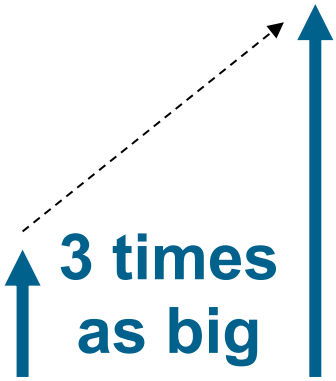
Children should be able to model a multiplication calculation using an array. This knowledge will support with the development of the grid method.

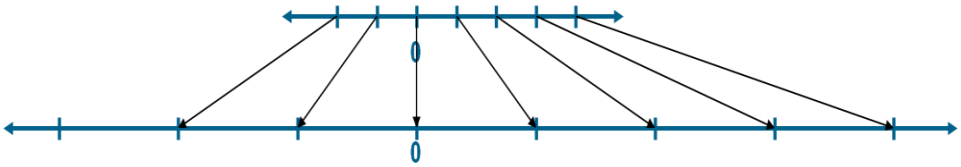


4 x 9 = 36

9 x 4 = 36

Children will also develop an understanding of scaling



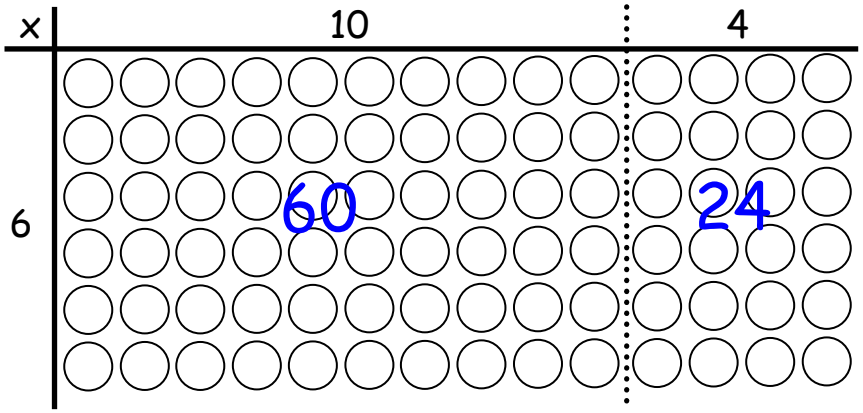


e.g. Find a ribbon that is 4 times as long as the blue ribbon

5 cm

20 cm

STAGE 4 – USING ARRAYS TO DEVELOP THE FORMAL WRITTEN METHOD

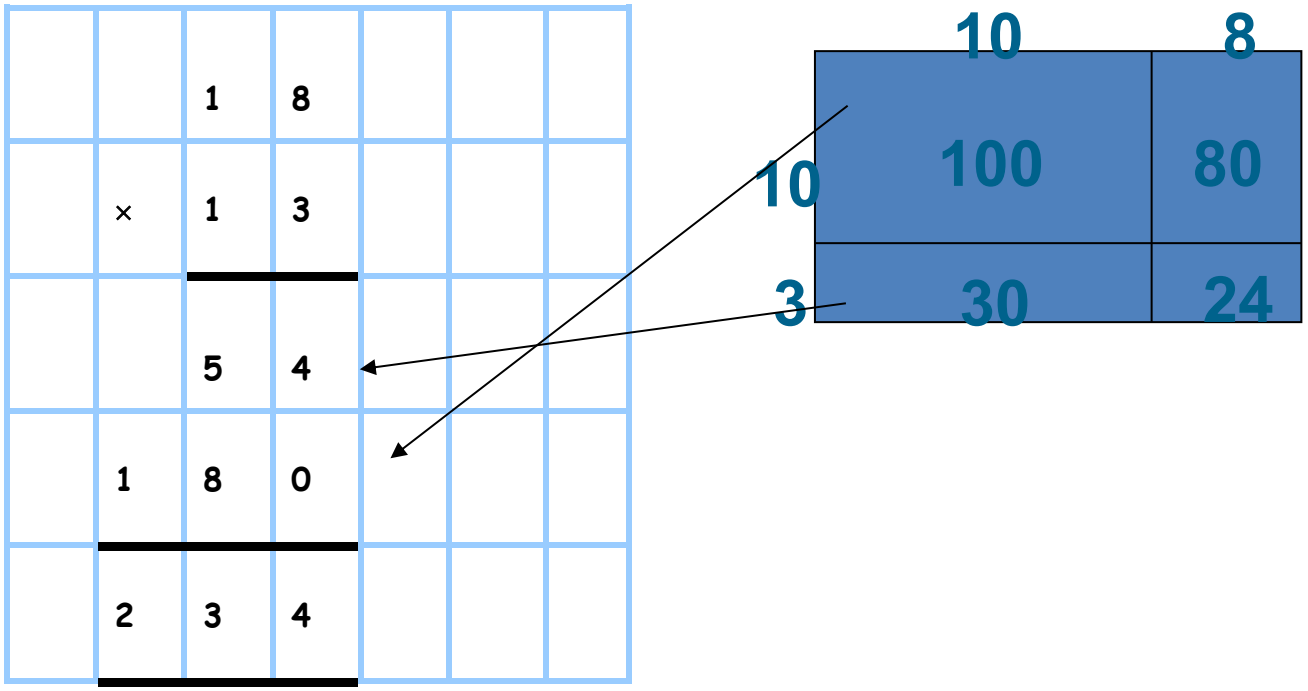


(6 x 10) + (6 x 4)

60 + 24

84

USING THE GRID METHOD TO DEVELOP THE FORMAL WRITTEN METHOD



STAGE 5 – Multiplying decimals

Using similar methods, they will be able to multiply decimals with one decimal place by a single digit number, approximating first. They should know that the decimal points line up under each other.

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

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

Using similar methods, they will be able to multiply decimals with up to two decimal places by a single digit number and then two digit numbers, approximating first. They should know that the decimal points line up under each other.

For example:

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

$$\begin{array}{r} 12 \\ +\ 0.7 \\ +\ 0.06 \\ \hline 12.76 \end{array}$$

Division

STAGE 1

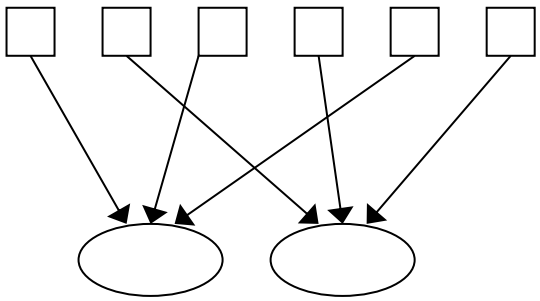
Children will understand equal groups and share items out in play and problem solving.
They will count in 2s and 10s and later in 5s.

STAGE 2

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

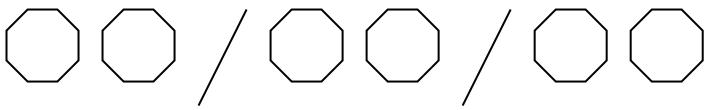
Sharing equally

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



Grouping or repeated subtraction

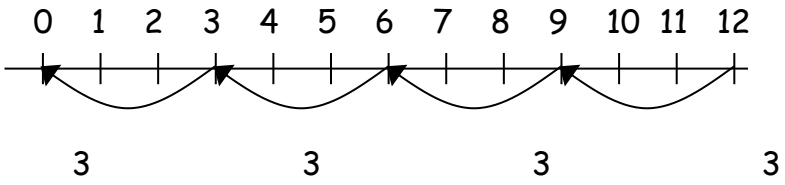
There are 6 sweets, how many people can have 2 sweets each?



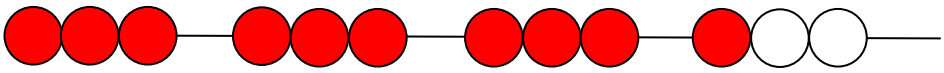
STAGE 3

Repeated subtraction using a number line or bead bar

12 ÷ 3 = 4

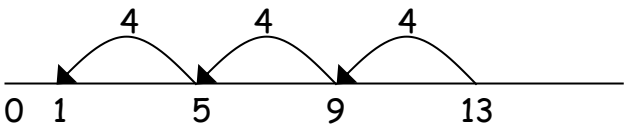


The bead bar will help children with interpreting division calculations such as 10 ÷ 5 as 'how many 5s make 10?'



Children should also move onto calculations involving remainders.

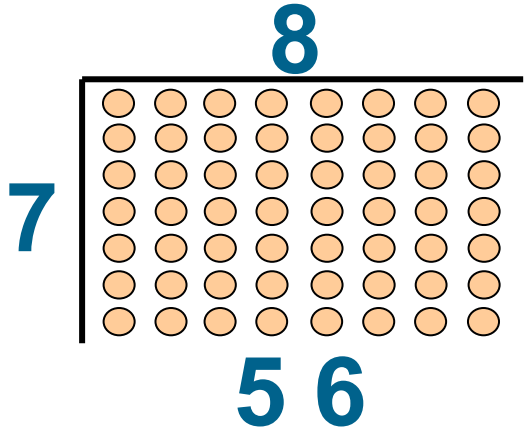
13 ÷ 4 = 3 r 1



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

26 ÷ 2 = □ 24 ÷ △ = 12 □ ÷ 10 = 8

STAGE 4 – Back to arrays



Arrays show both the multiplication and the division.

7 x 8 = 56
8 x 7 = 56
56 ÷ 7 = 8
56 ÷ 8 = 7

STAGE 5 – The chunking method for long division

72 ÷ 3

72
- 30 (10 x 3)
42
- 30 (10 x 3)
12 (4 x 3)

10 + 10 + 4 = 24

72 ÷ 3 = 24

114 ÷ 6

114
- 60 (10 x 6)
54
- 30 (5 x 6)
24 (4 x 6)

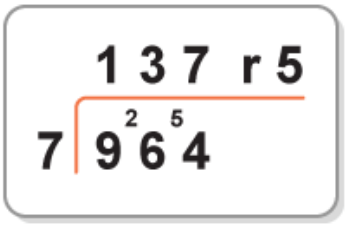
10 + 5 + 4 = 19

114 ÷ 6 = 19

STAGE 6 – Short division

Then onto the vertical method:

Short division TU ÷ U



The children at this stage will also be taught how to add decimal numbers so that the remainder is shown as a decimal. The children will have opportunities to use this method in problems so they know whether a decimal or remainder is appropriate.

By the end of year 6, children will use the formal written methods for written calculations. They will have a range of strategies for mental calculations. Children should not be made to go onto the next stage if:

1) **they are not ready.**
2) **they are not confident.**

Children should be encouraged to approximate their answers before calculating. Children should be encouraged to check their answers after calculation using an appropriate strategy.