

PROGRESSION THROUGH CALCULATIONS FOR SUBTRACTION

MENTAL CALCULATIONS

These are a **selection** of mental calculation strategies:

See NNS Framework Section 5, pages 30-41 and Section 6, pages 40-47

Mental recall of addition and subtraction facts

$$10 - 6 = 4$$

$$17 - \square = 11$$

$$20 - 17 = 3$$

$$10 - \square = 2$$

Find a small difference by counting up

$$82 - 79 = 3$$

Counting on or back in repeated steps of 1, 10, 100, 1000

$$86 - 52 = 34 \text{ (by counting back in tens and then in ones)}$$

$$460 - 300 = 160 \text{ (by counting back in hundreds)}$$

Subtract the nearest multiple of 10, 100 and 1000 and adjust

$$24 - 19 = 24 - 20 + 1 = 5$$

$$458 - 71 = 458 - 70 - 1 = 387$$

Use the relationship between addition and subtraction

$$36 + 19 = 55$$

$$19 + 36 = 55$$

$$55 - 19 = 36$$

$$55 - 36 = 19$$

*MANY MENTAL CALCULATION STRATEGIES WILL CONTINUE TO BE USED.
THEY ARE NOT REPLACED BY WRITTEN METHODS.*

THE FOLLOWING ARE GUIDELINES TO AGE RELATED EXPECTATIONS

Reception and Year 1

Pupils 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.

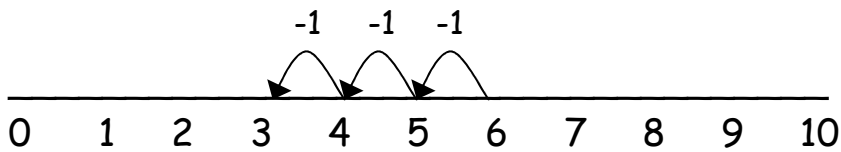


8 - 3 =

$8 - 3 = 5$	$8 - 5 = 3$
$5 + 3 = 8$	$3 + 5 = 8$

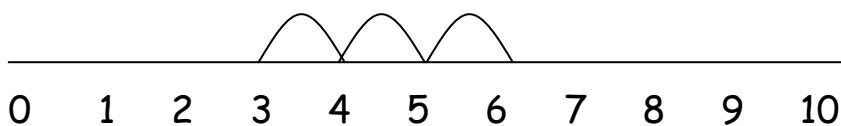
They use number lines and practical resources to support calculation. Teachers *demonstrate* the use of the number line.

$6 - 3 = 3$



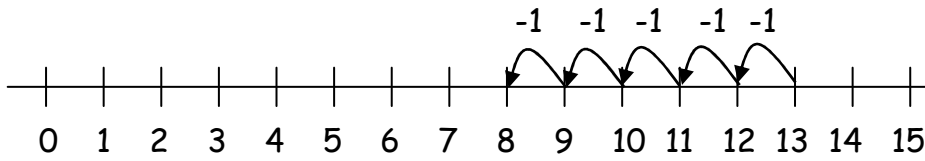
The number line should also be used to show that $6 - 3$ means the 'difference between 6 and 3' or 'the difference between 3 and 6' and how many jumps they are apart.

Difference 1.2.exe



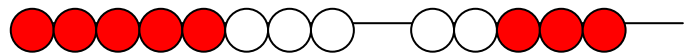
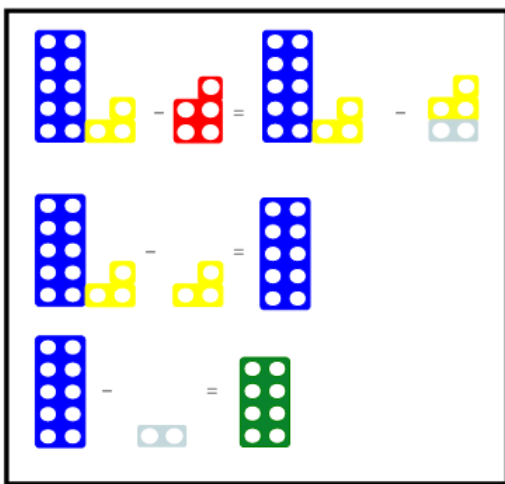
Pupils then begin to use numbered lines to support their own calculations - using a numbered line to count back in ones.

$$13 - 5 = 8$$



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

$$13 - 5 = 8$$



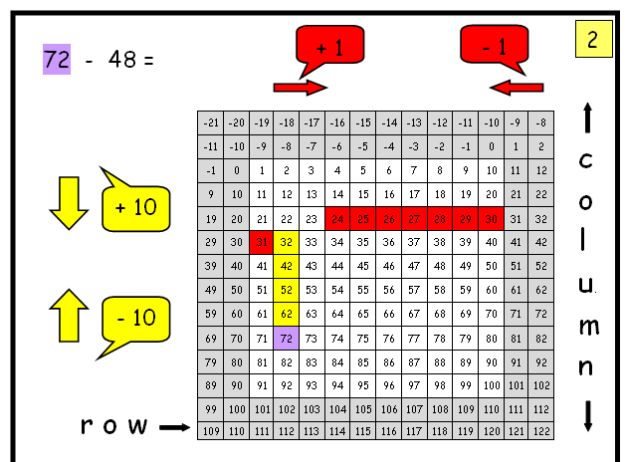
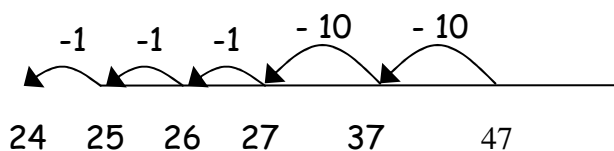
Year 2

Pupils will begin to use extended hundred squares and empty number lines to support calculations.

Counting back

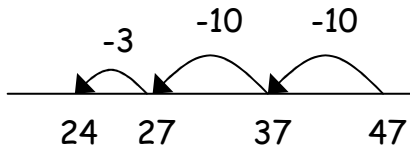
✓ First counting back in tens and ones.

$$47 - 23 = 24$$



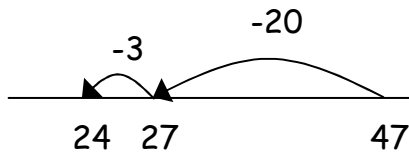
- ✓ Then helping pupils to become more efficient by subtracting the units in one jump (by using the known fact $7 - 3 = 4$).

$$47 - 23 = 24$$



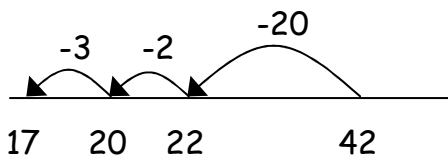
- ✓ Subtracting the tens in one jump and the units in one jump.

$$47 - 23 = 24$$



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

$$42 - 25 = 17$$



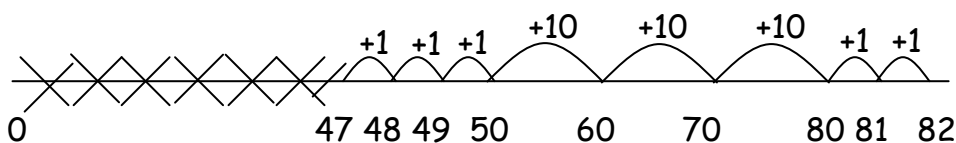
Counting on

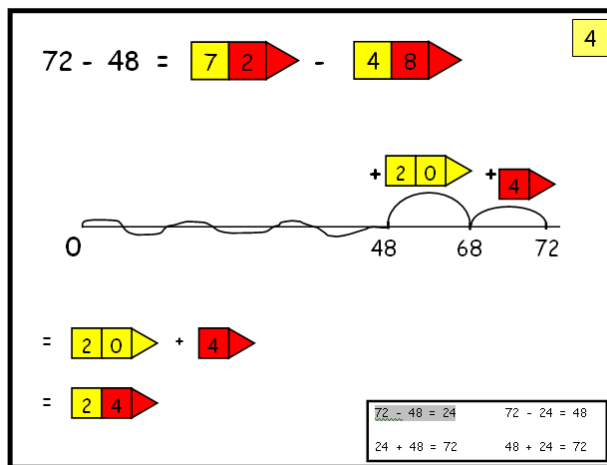
If the numbers involved in the calculation are close together or near to multiples of 10, 100 etc, it can be more efficient to count on.

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

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

$$82 - 47$$





Help pupils 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.

Year 3

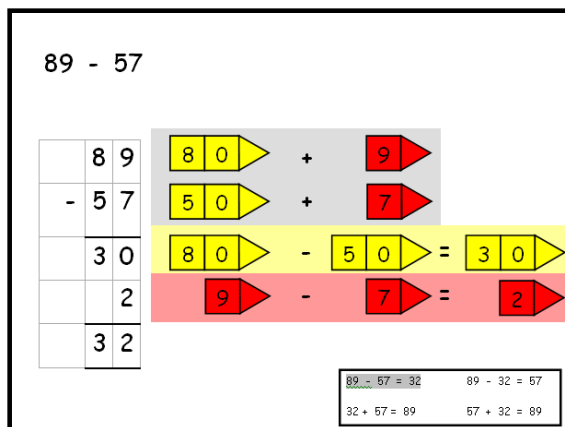
Pupils will continue to use empty number lines with increasingly large numbers.

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

NOTE When solving the calculation $89 - 57$, pupils 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 materials or Numicon, pupils would need to count out only the 89.



$$\begin{array}{r}
 89 \\
 - 57 \\
 \hline
 \end{array}
 =
 \begin{array}{r}
 80 + 9 \\
 50 + 7 \\
 \hline
 30 + 2 = 32
 \end{array}$$

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

From this the pupils will begin to exchange.

$$\begin{array}{r} 72 \\ - 48 \\ \hline \end{array}$$

Step 1

$$\begin{array}{r} 70 + 2 \\ - 40 + 8 \\ \hline \end{array}$$

The calculation should be read as e.g. take 8 from 2.

Step 2

$$\begin{array}{r} 60 + 12 \\ - 40 + 8 \\ \hline 20 + 4 = 24 \end{array}$$

This would be recorded by the pupils as

$$\begin{array}{r} \cancel{70}^{60} + 12 \\ - 40 + 8 \\ \hline 20 + 4 = 24 \end{array}$$

72 - 48

	7	2
-	4	8

70 + 2
40 + 8

60 + 12
70 + 8
40 + 8

72 - 48 = 24 72 - 24 = 48
24 + 48 = 72 48 + 24 = 72

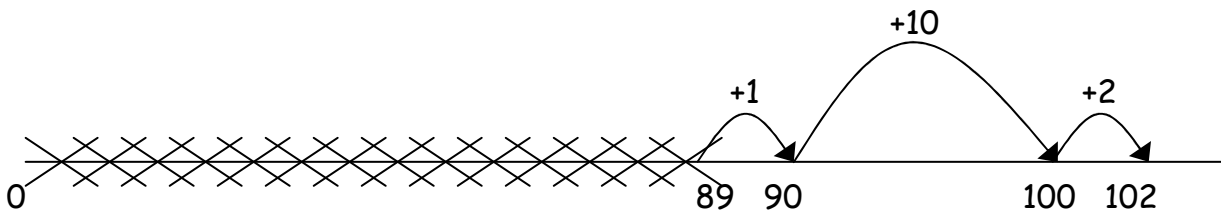
Pupils should know that units line up under units, tens under tens, and so on.

If your school feels that the use of addition signs within a subtraction calculation will cause confusion, then they can be replaced with arrows, as in the example below. This needs to be agreed as part of the whole school policy and applied consistently throughout the school.

$$\begin{array}{r} 89 \\ - 57 \\ \hline \end{array} = \begin{array}{r} 80 \rightarrow 9 \\ 50 \rightarrow 7 \\ 30 \rightarrow 2 = 32 \end{array}$$

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.

$$102 - 89 = 13$$



Year 4

Partitioning and decomposition

7 5 4	700	+	50	+	4
- 8 6	-	+	80	+	6
7 4 14	700	+	40	+	14
- 8 6	-	+	80	+	6
6 14 14	600	+	140	+	14
- 8 6	-	+	80	+	6
6 6 8	600	+	60	+	8

$$\begin{array}{r} 754 \\ - 86 \\ \hline \end{array}$$

$$\begin{array}{r} \text{Step 1} \quad 700 + 50 + 4 \\ - \quad \quad \quad 80 + 6 \\ \hline \end{array}$$

$$\begin{array}{r} \text{Step 2} \quad 700 + 40 + 14 \quad (\text{adjust from } T \text{ to } U) \\ - \quad \quad \quad 80 + 6 \\ \hline \end{array}$$

$$\begin{array}{r} \text{Step 3} \quad 600 + 140 + 14 \quad (\text{adjust from } H \text{ to } T) \\ - \quad \quad \quad 80 + 6 \\ \hline 600 + 60 + 8 = 668 \end{array}$$

This would be recorded by the pupils as

$$\begin{array}{r}
 \overset{600}{\cancel{700}} + \overset{140}{\cancel{50}} + 14 \\
 - \quad \quad \quad 80 + 6 \\
 \hline
 600 + 60 + 8 = 668
 \end{array}$$

Decomposition

$$\begin{array}{r}
 713 \ 1 \\
 \cancel{842} \\
 - 276 \\
 \hline
 668
 \end{array}$$

842 - 276

30 minus 70

130 minus 70 is 60

Change 800 to 700 + 100

Change 40 to 30 + 10

2 minus 6

700 minus 200 is 500

12 minus 6 is 6

8	4	2
-	2	7
	5	6

842 - 276 = 566 842 - 566 = 276
 566 + 276 = 842 276 + 566 = 842

Pupils should:

- ✓ be able to subtract numbers with different numbers of digits;
- ✓ using this method, pupils should also 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.
- ✓ be able to use a number line to help in making the calculation

For example:

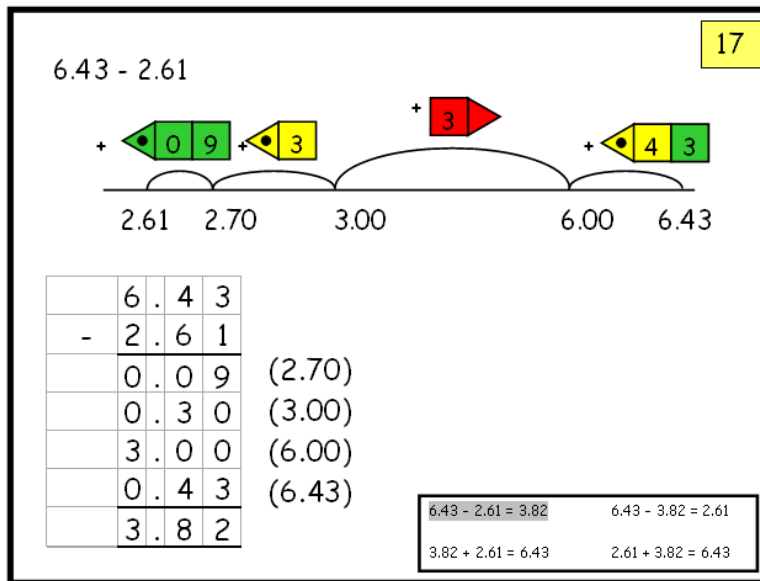
$$\begin{array}{r}
 \pounds 8.95 = 8 + 0.9 + 0.05 \\
 - \pounds 4.38 = 4 + 0.3 + 0.08 \\
 \hline
 = 8 + 0.8 + 0.15 \quad (\text{adjust from } T \text{ to } U) \\
 - 4 + 0.3 + 0.08 \\
 \hline
 4 + 0.5 + 0.07 \\
 = \pounds 4.57
 \end{array}$$

leading to

$$\begin{array}{r}
 8.85 \\
 - 4.38 \\
 \hline
 \end{array}$$

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

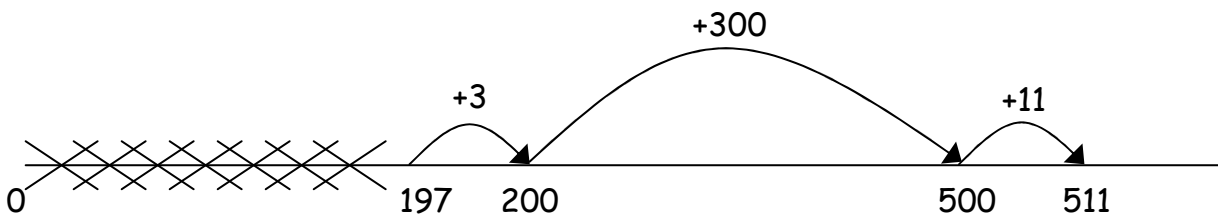
Using a number line to help in making the calculation.



NB If your pupils have reached the concise stage they will then continue this method through into years 5 and 6. They will not go back to using the expanded methods.

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.

$511 - 197 = 314$



Year 5

Partitioning and decomposition

$$\begin{array}{r} \text{Step 1} \quad 754 = 700 + 50 + 4 \\ - 286 \quad - 200 + 80 + 6 \end{array}$$

$$\begin{array}{r} \text{Step 2} \quad \quad 700 + 40 + 14 \quad (\text{adjust from T to U}) \\ - 200 + 80 + 6 \end{array}$$

$$\begin{array}{r} \text{Step 3} \quad \quad 600 + 140 + 14 \quad (\text{adjust from H to T}) \\ - 200 + 80 + 6 \\ \hline 400 + 60 + 8 = 468 \end{array}$$

This would be recorded by the pupils as

$$\begin{array}{r} \overset{600}{\cancel{700}} + \overset{140}{\cancel{50}} + 14 \\ - 200 + 80 + 6 \\ \hline 400 + 60 + 8 = 468 \end{array}$$

Decomposition

$$\begin{array}{r} 614 \text{ } 1 \\ \cancel{7} \cancel{5} 4 \\ - 286 \\ \hline 468 \end{array}$$

11

8 4 2		8 0 0	+	4 0	+	2
- 2 7 6		- 2 0 0	+	7 0	+	6
8 ³ 4 12		8 0 0	+	4 0	+	1 2
- 2 7 6		- 2 0 0	+	7 0	+	6
7 ⁸ ¹³ 4 12		8 0 0	+	4 0	+	1 2
- 2 7 6		- 2 0 0	+	7 0	+	6
5 6 6		7 0 0	+	1 3 0	+	6
		5 0 0	+	6 0	+	6

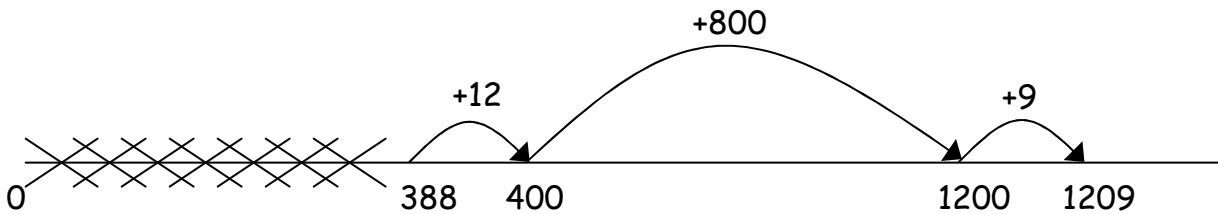
Pupils should:

- ✓ 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.

NB If your pupils have reached the concise stage they will then continue this method through into year 6. They will not go back to using the expanded methods.

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.

$$1209 - 388 = 821$$



Year 6

Decomposition

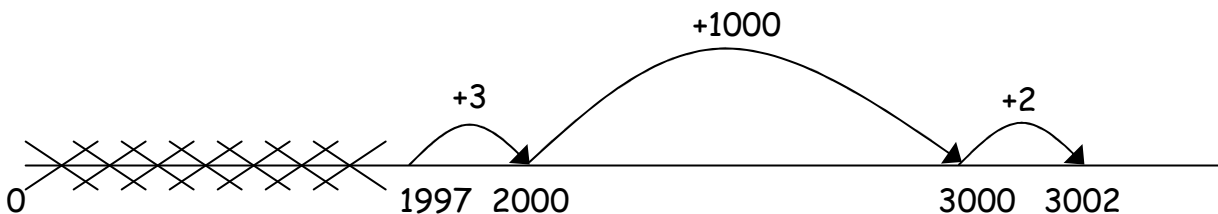
$$\begin{array}{r}
 5131 \\
 6\cancel{4}67 \\
 - 2684 \\
 \hline
 3783
 \end{array}$$

Pupils 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 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.

$$3002 - 1997 = 1005$$



By the end of year 6, pupils will have a range of calculation methods, mental and written. Selection will depend upon the numbers involved.

Pupils should not be made to go onto the next stage if:

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

Pupils should be encouraged to approximate their answers before calculating.

Pupils should be encouraged to check their answers after calculation using an appropriate strategy.

Pupils should be encouraged to consider if a mental calculation would be appropriate before using written methods.

**A COMPLETE SET OF WRITTEN METHODS POSTERS FOR THE FOUR RULES ARE
AVAILABLE FROM THE LEA**