

## PROGRESSION THROUGH CALCULATIONS FOR SUBTRACTION

### MENTAL CALCULATIONS

(ongoing)

These are a selection of mental calculation strategies:

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

$$36 + 19 = 55$$

$$19 + 36 = 55$$

$$55 - 19 = 36$$

$$55 - 36 = 19$$

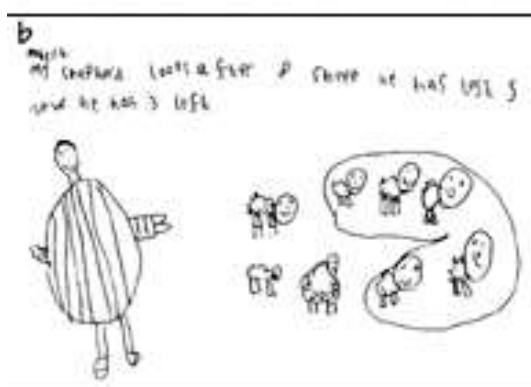
*MANY MENTAL CALCULATION STRATEGIES WILL CONTINUE TO BE USED. THEY ARE NOT REPLACED BY WRITTEN METHODS.*

THE FOLLOWING ARE STANDARDS THAT WE EXPECT THE MAJORITY OF CHILDREN TO ACHIEVE.

### Stage 1

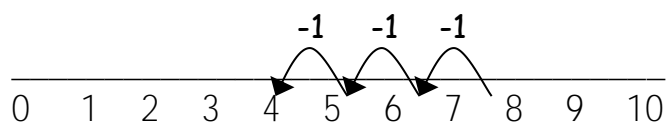
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Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures etc.

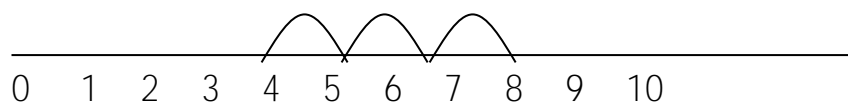


They use numberlines and practical resources to support calculation. Teachers *demonstrate* the use of the numberline.

$$6 - 3 = 3$$

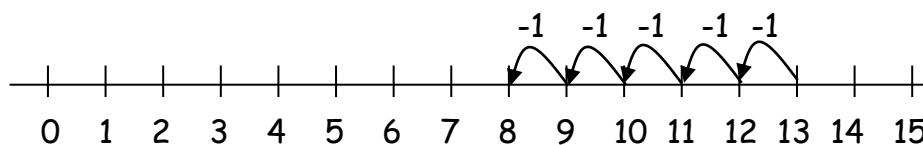


The numberline should also be used to show that  $6 - 3$  means the 'difference between 6 and 3' or 'the difference between 3 and 6' and how many jumps they are apart.



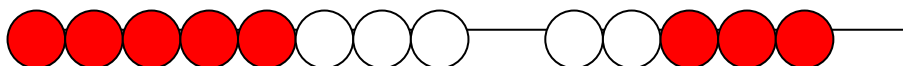
Children then begin to use numbered lines to support their own calculations - using a numbered line to count back in ones.

$$13 - 5 = 8$$



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

$$13 - 5 = 8$$



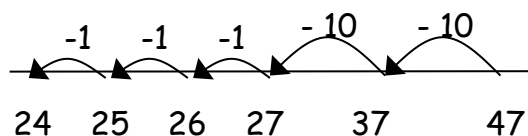
## Stage 2

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

Counting back

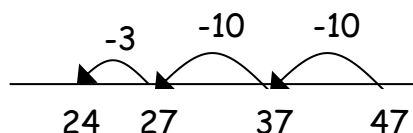
- ✓ First counting back in tens and ones.

$$47 - 23 = 24$$



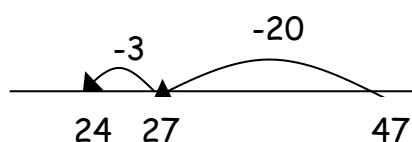
- ✓ Then helping children to become more efficient by subtracting the units in one jump (by using the known fact  $7 - 3 = 4$ ).

$$47 - 23 = 24$$



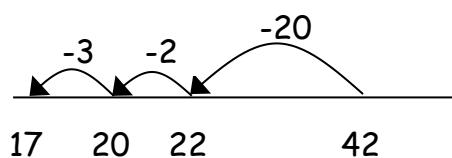
- ✓ Subtracting the tens in one jump and the units in one jump.

$$47 - 23 = 24$$



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

$$42 - 25 = 17$$



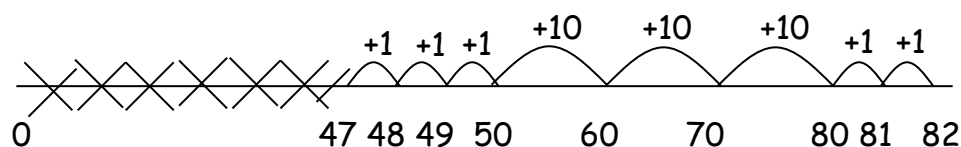
Counting on

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.

### Stage 3

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 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  $89 - 57$ , 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 materials, children 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 children will be taught using examples that do not need the children to exchange.*

From this the children will begin to exchange.

$$\begin{array}{r} 71 \\ - 46 \\ \hline \end{array} = \quad =$$

$$\text{Step 1} \quad \begin{array}{r} 70 + 1 \\ - 40 + 6 \\ \hline \end{array}$$

$$\text{Step 2} \quad \begin{array}{r} 60 + 11 \\ - 40 + 6 \\ \hline 20 + 5 = 25 \end{array}$$

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

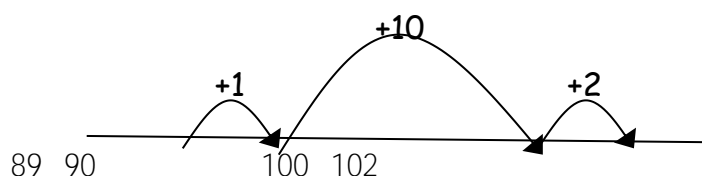
This would be recorded by the children as

$$\begin{array}{r} 60 \\ \cancel{70} + 11 \\ - \cancel{40} + 6 \\ \hline 20 + 5 = 25 \end{array}$$

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

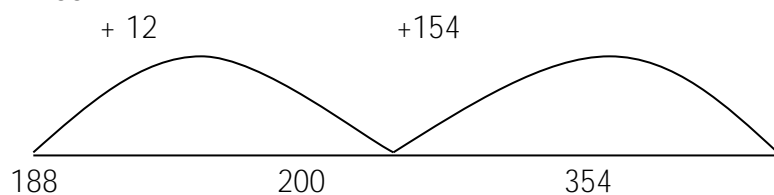
Where the numbers in the calculation are close together or near to multiples of 10, 100 etc counting on using a number line should be used.

$$102 - 89 = 13$$

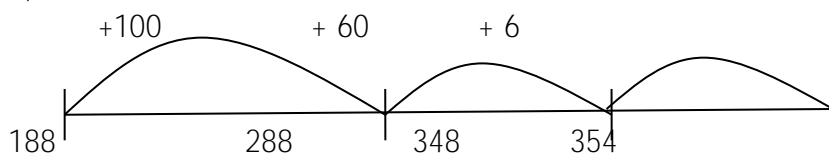


The above method can be extended to larger numbers by using complements to 100.

$$354 - 188 =$$



and,



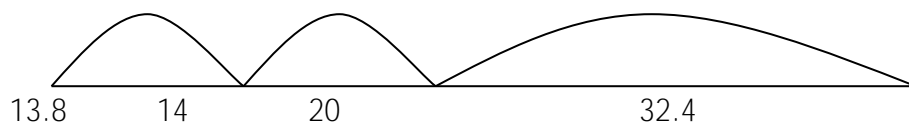
$$354 - 188 = 166$$

Subtraction of decimals is just as simple using the number line.

$$32.4 - 13.8$$

$$+ 0.2 \quad + 6 \quad + 12.4$$

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$$32.4 - 13.8 = 18.6$$

### Stage 4

The aim is for the children to be secure in a method for subtraction. There should be no pressure for children to have to progress through all the methods too quickly. Some children may leave Year 6 confidently working in subtraction on a number line.

Partitioning and decomposition

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

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

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

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

This would be recorded by the children as

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

Lots of decomposition would make this method error prone, the children need to be encouraged to know this and understand that a number line can still be used. It would not be a step backwards to use a number line.

### Decomposition

$$\begin{array}{r} 6141 \\ \cancel{754} \\ - 86 \\ \hline 668 \end{array}$$

Children should:

- ✓ be able to subtract numbers with different numbers of digits;

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- ✓ using this method, children 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.

For example:

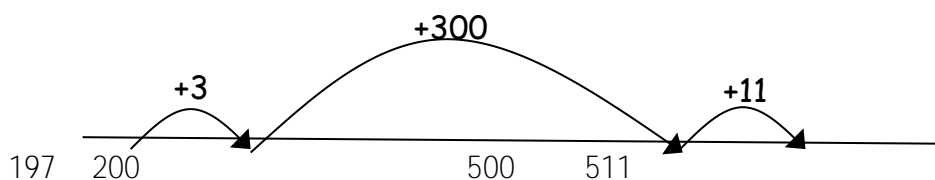
$$\begin{array}{r}
 \text{£}8.95 \\
 - \text{£}4.38 \\
 \hline
 \end{array}
 =
 \begin{array}{r}
 8 + 0.9 + 0.05 \\
 - 4 + 0.3 + 0.08 \\
 \hline
 \end{array}$$

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

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

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.

$$511 - 197 = 314$$



## Stage 5

Partitioning and decomposition

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

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

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

Please note, this calculation is shown just as an example for the method. A calculation like this, needing so much partitioning and decomposition may be more efficient and accurate on a number line.

This would be recorded by the children as

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

Decomposition

$$\begin{array}{r} 6141 \\ \quad \cancel{754} \\ - \underline{286} \\ \quad 468 \end{array}$$

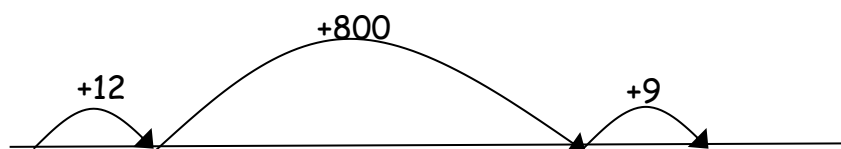
Children should:

- ✓ 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.

*NB If your children have reached the concise stage they will then continue this method. 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.

$$1209 - 388 = 821$$





388 400

1200

1209

## Stage 6

### Decomposition

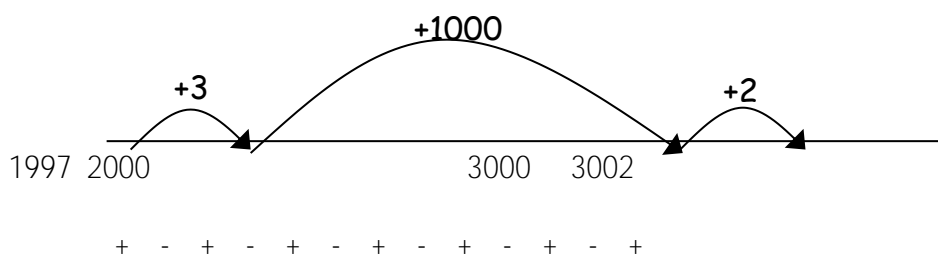
$$\begin{array}{r} // \quad \begin{array}{c} 5 \ 13 \ 1 \\ 6467 \\ - 2684 \\ \hline 3783 \end{array} \end{array}$$

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 be used.

$$3002 - 1997 = 1005$$



By the end of year 6, children will have a range of calculation methods, mental and written. Children should always be encouraged to think whether they can work mentally, or need to jot or use their written method.

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.

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