

St. John's CofE Primary Calculation Policy



Calculation Policy

The maths that your child does at school may look very different to the kind of 'sums' that you remember.

This policy is designed as a guide to how calculation methods and strategies are taught in school and the progression of skills that are developed. From nursery right through to the end of Year 6, children are developing a range of calculation methods. These may be pictorial, practical, oral and mental (with or without 'jottings') as well as written and calculator methods.

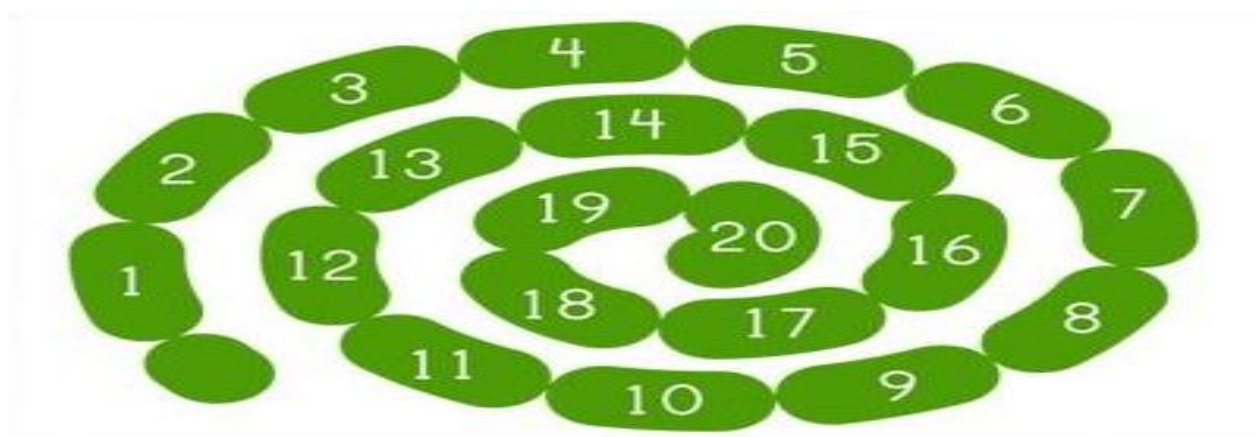
Choice of methods will usually depend on the numbers involved and previous experience.

Children will progress through different methods according to their own readiness and confidence. Accordingly, children within one class or year group will be at different stages.

As children progress through the school, they are increasingly encouraged to:

- approximate their answers before calculating;
- choose an efficient method;
- check their answers after calculation using an appropriate strategy;
- consider if a mental calculation would be appropriate before using written methods

In considering written calculations (which may also be known as 'compact', 'standard', 'traditional' or 'formal'), children work through a progression of calculation methods so that ultimately they know, understand and can reliably use a written method for each numerical operation.



PROGRESSION THROUGH CALCULATIONS FOR ADDITION

MENTAL CALCULATIONS

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

Mental recall of number bonds

$$6 + 4 = 10$$

$$25 + 75 = 100$$

$$+ 3 = 10$$

$$19 + \quad = 20$$

Use near doubles

$$6 + 7 = \text{double } 6 + 1 = 13$$

Addition using partitioning and recombining

$$34 + 45 = (30 + 40) + (4 + 5) = 79$$

Count on in repeated steps of 1, 10, 100, 1000

$$86 + 57 = 143 \text{ (by counting on in tens and then in ones)}$$

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

$$24 + 19 = 24 + 20 - 1 = 43$$

$$458 + 71 = 458 + 70 + 1 = 529$$

Use the relationship between addition and subtraction

$$36 + 19 = 55$$

$$55 - 19 = 36$$

$$19 + 36 = 55$$

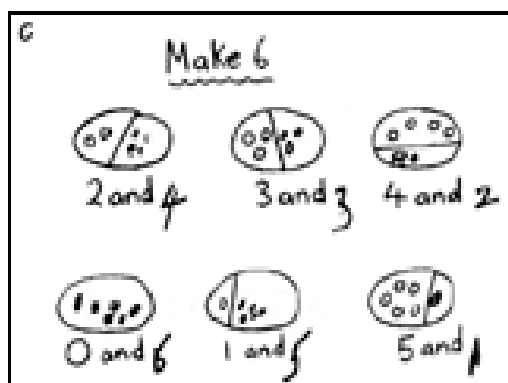
$$55 - 36 = 19$$

*MENTAL CALCULATION STRATEGIES ARE ALWAYS
ENCOURAGED TO BE USED ALONGSIDE WRITTEN METHODS*

WRITTEN CALCULATIONS

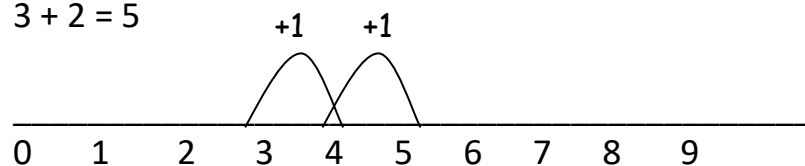
The following is a suggested progression through written calculation strategies.

- develop a mental picture of the number system to use for calculation
- use physical objects and develop ways of representing calculations visually such as through pictures

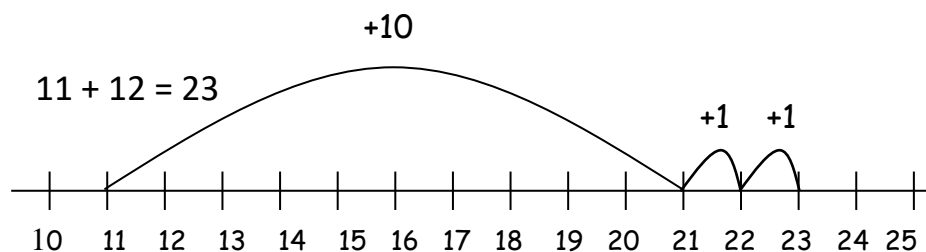


- use number lines to support calculations, initially counting on in ones

$$3 + 2 = 5$$



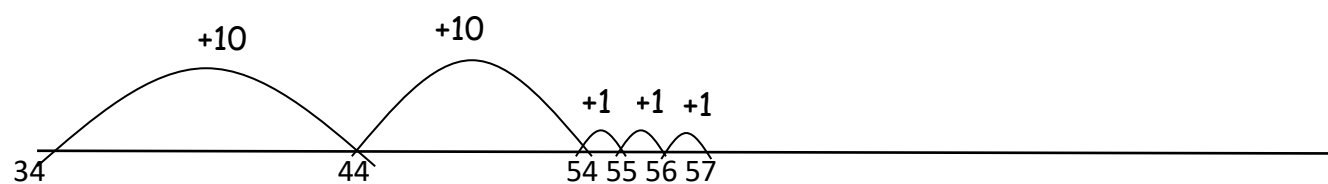
- count on in tens and ones with the aid of a number line



- use 'empty number lines', starting with the larger number and counting on

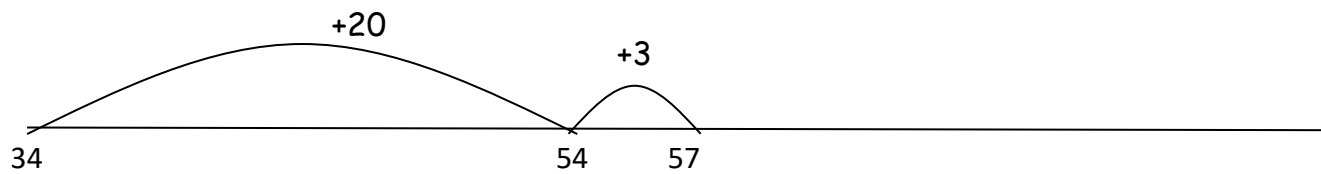
i) counting on in tens and ones.

$$34 + 23 = 57$$



ii) counting on the tens in one jump and the units in one jump.

$$34 + 23 = 57$$



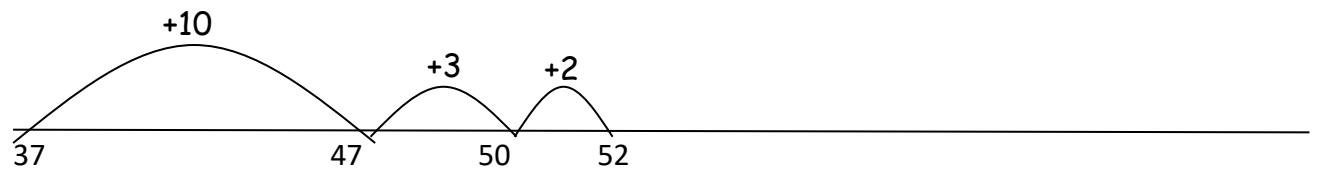
iii) use jottings to record calculations

$$34 + 23 = 57$$

$$30 + 20 = 50 \quad \textcircled{+} 4 + 3 = 7 \quad \textcircled{+} 50 + 7 = 57$$

- use number lines to 'bridge' through ten, supported by jottings

$$37 + 15 = 52$$

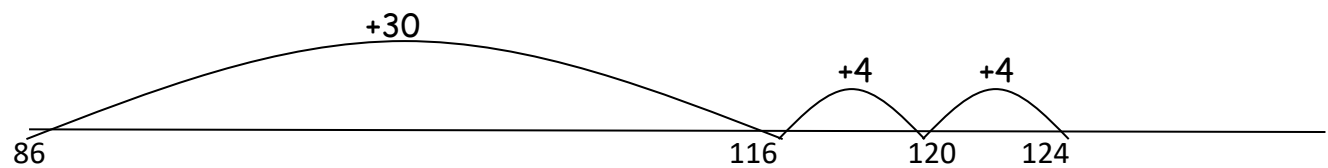


$$37 + 15 = 52$$

$$30 + 10 = 40 \quad \textcircled{+} 7 + 5 = 12 \quad \textcircled{+} 40 + 12 = 52$$

- use empty number lines with larger numbers, supported by jottings

$$38 + 86 = 124$$

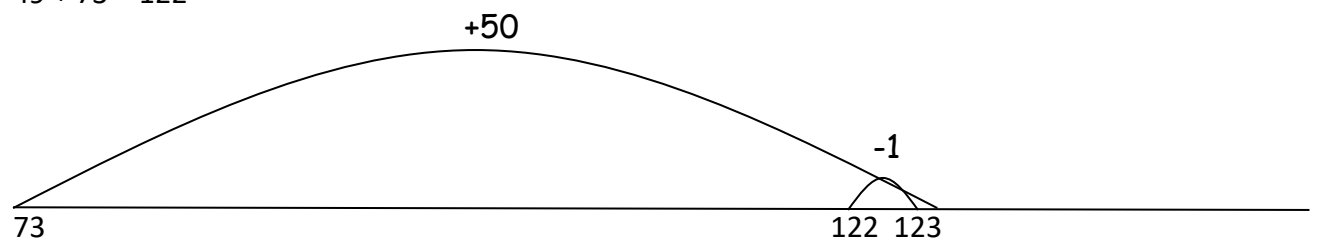


$$38 + 86 = 124$$

$$86 + 30 = 116 \quad \textcircled{+} 116 + 8 = 124$$

- use 'compensation' when adding numbers

$$49 + 73 = 122$$



$$49 + 73 = 122$$

$$73 + 50 = 123 \quad \textcircled{A} \quad 123 - 1 = 122$$

- arrange numbers vertically, adding the most significant digits first

$$\begin{array}{r} 67 \\ + 24 \\ \hline 80 \text{ (60 + 20)} \\ \underline{11} \text{ (7 + 4)} \\ 91 \end{array}$$

$$\begin{array}{r} 267 \\ + 85 \\ \hline 200 \\ 140 \text{ (60 + 80)} \\ \underline{12} \text{ (7 + 5)} \\ 352 \end{array}$$

- add the least significant digits first in preparation for 'carrying'.

$$\begin{array}{r} 67 \\ + 24 \\ \hline 11 \text{ (7 + 4)} \\ \underline{80} \text{ (60 + 20)} \\ 91 \end{array}$$

$$\begin{array}{r} 267 \\ + 85 \\ \hline 12 \text{ (7 + 5)} \\ 140 \text{ (60 + 80)} \\ \underline{200} \\ 352 \end{array}$$

- add numbers vertically using 'carrying'

$$\begin{array}{r} 625 \\ + 48 \\ \hline 673 \\ \underline{1} \end{array}$$

$$\begin{array}{r} 783 \\ + 62 \\ \hline 845 \\ \underline{1} \end{array}$$

$$\begin{array}{r} 367 \\ + 585 \\ \hline 952 \\ \underline{11} \end{array}$$

- perform addition with any number of digits, including decimals

$$\begin{array}{r} 7648 \\ + 1486 \\ \hline 9134 \\ \underline{111} \end{array}$$

$$\begin{array}{r} 6584 \\ + 5848 \\ \hline 12432 \\ \underline{111} \end{array}$$

$$\begin{array}{r} 16.3 \\ + 6.47 \\ \hline 22.77 \\ \underline{1} \end{array}$$

PROGRESSION THROUGH CALCULATIONS FOR SUBTRACTION

MENTAL CALCULATIONS

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

Mental recall of addition and subtraction facts

$$10 - 6 = 4$$

$$17 - \quad = 11$$

$$20 - 17 = 3$$

$$10 - \quad = 2$$

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 ALONGSIDE WRITTEN METHODS*

WRITTEN CALCULATIONS

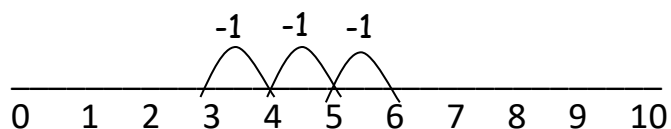
The following is a suggested progression through written calculation strategies.

- develop a mental picture of the number
- use physical objects and develop ways of recording calculations using pictures

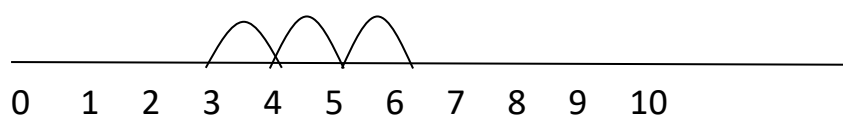


- use number lines and practical resources to support calculation, initially counting back in ones.

$$6 - 3 = 3$$

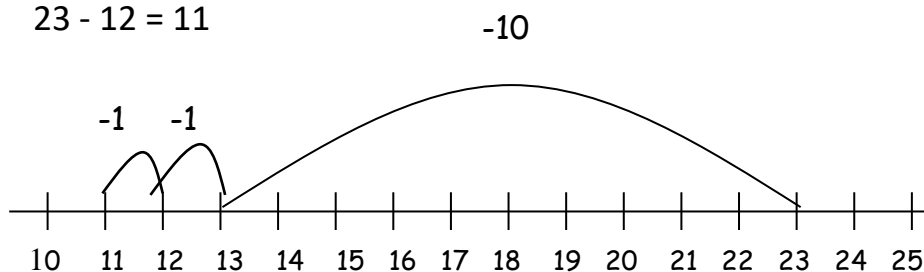


- use number lines to show that $6 - 3$ means the 'difference between 6 and 3' or 'the difference between 3 and 6' and how many jumps they are apart.



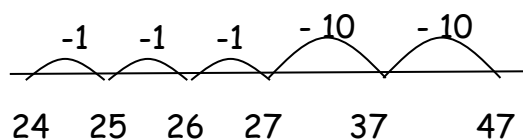
- count back in tens and ones with the aid of a number line

$$23 - 12 = 11$$



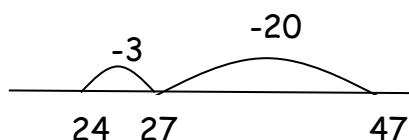
- use empty number lines to support calculations, counting back in tens and ones

$$47 - 23 = 24$$



- subtract the tens in one jump and the units in one jump, using jottings for support

$$47 - 23 = 24$$

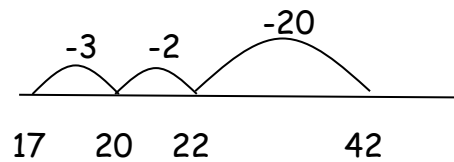


$$47 - 23 = 24$$

$$40 - 20 = 20 \quad 7 - 3 = 4 \quad 20 + 4 = 24$$

- use number lines to 'bridge' through ten, supported by jottings

$$42 - 25 = 17$$

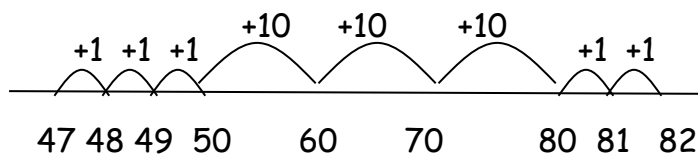


$$42 - 25 = 17$$

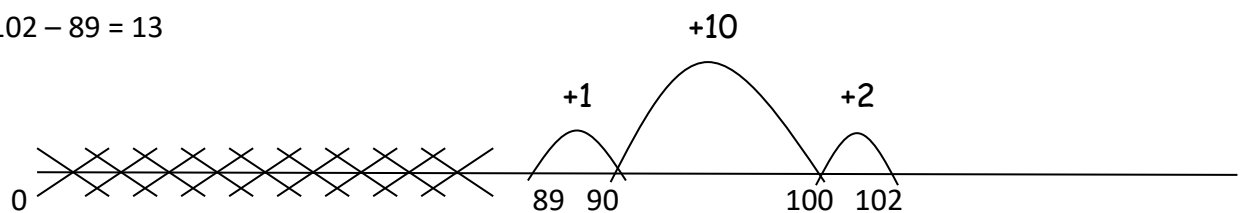
$$42 - 20 = 22 \quad 22 - 5 = 17$$

- use number lines to count on, especially if the numbers involved in the calculation are close together or near to multiples of 10, 100

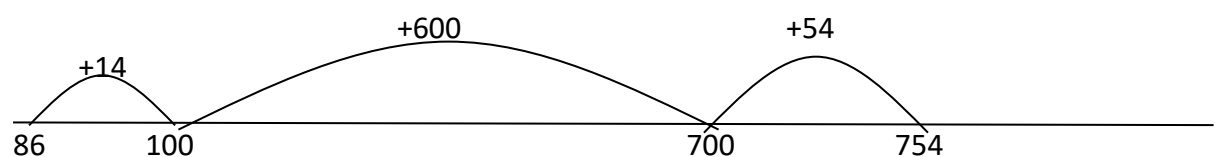
$$82 - 47 = 35$$



$$102 - 89 = 13$$



$$754 - 86 = 668$$



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

- use practical materials to show the composition of each number involved in a subtraction calculation, initially without exchange

$$89 - 57$$

$$\begin{array}{r} 80 \text{ and } 9 \\ - 50 \text{ and } 7 \\ \hline 30 \text{ and } 2 \end{array} = 32$$

- use practical materials, decomposition and exchange between tens and ones for a subtraction calculation

$$71 - 46$$

$$\begin{array}{l} \text{Step 1} \quad \begin{array}{r} 70 \text{ and } 1 \\ - 40 \text{ and } 6 \\ \hline \end{array} \\ \text{Step 2} \quad \begin{array}{r} 60 \text{ and } 11 \\ - 40 \text{ and } 6 \\ \hline 20 \text{ and } 5 \end{array} = 25 \end{array}$$

This would be read as
'1 take away 6'

- use a compact form of recording subtraction with exchange, aligning digits accurately under one another

$$\begin{array}{r} \overset{6}{\swarrow} \overset{1}{1} \\ - \quad 4 \ 6 \\ \hline \quad 2 \ 5 \end{array}$$

- use practical materials, decomposition and exchange between
i) hundreds and tens and ii) tens and ones

$$754 - 286$$

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

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

$$\text{Step 3} \quad 600 + 140 + 14 \quad (\text{adjust from H to T})$$

$$\begin{array}{r} - 200 + 80 + 6 \\ 400 + 60 + 8 = 468 \end{array}$$

recorded as

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

- use a compact form of recording subtraction with exchange, aligning digits accurately under one another

$$\begin{array}{r} 6 \ 14 \ 1 \\ \cancel{7} \cancel{0} \cancel{4} \\ - 286 \\ \hline 468 \end{array}$$

- perform subtraction with any number of digits, including decimals

$$\begin{array}{r} 5 \ 13 \ 1 \\ \cancel{6} \cancel{4} \cancel{6} \cancel{7} \\ - 2684 \\ \hline 3783 \end{array}$$

$$\begin{array}{r} 8 \ 1 \\ \cancel{5} \cancel{9} \cancel{5} \cancel{2} \\ - 23.7 \\ \hline 25.82 \end{array} /$$

PROGRESSION THROUGH CALCULATIONS FOR MULTIPLICATION

MENTAL CALCULATIONS

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

Doubling and halving

Applying the knowledge of doubles and halves to known facts,
e.g. 8×4 is double 4×4

Commutativity

Children should know that 3×5 has the same answer as 5×3 .

Using multiplication facts

Activities related to times tables form a regular part of the mathematics lessons from KS1 upwards.

By the end of Year 4, children should be able to derive and recall all multiplication facts up to 12×12 .

By the end of Year 6, they should also be able to derive and recall quickly related division facts up to 12×12 .

Using and applying division facts

Children should be able to utilise their tables knowledge to derive other facts.

e.g. If I know $3 \times 7 = 21$, what else do I know?

$30 \times 7 = 210$, $300 \times 7 = 2100$, $3000 \times 7 = 21\,000$, $0.3 \times 7 = 2.1$ etc

Use closely related facts already known

$$\begin{aligned} 13 \times 11 &= (13 \times 10) + (13 \times 1) \\ &= 130 + 13 \\ &= 143 \end{aligned}$$

Multiplying by 10 or 100

Knowing that the effect of multiplying by 10 is a shift in the digits one place to the left.

Knowing that the effect of multiplying by 100 is a shift in the digits two places to the left.

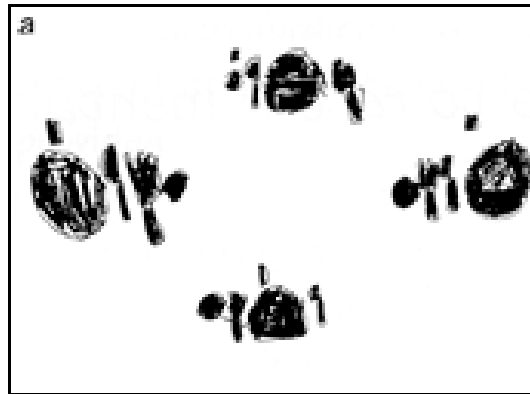
Partitioning

$$\begin{aligned} 23 \times 4 &= (20 \times 4) + (3 \times 4) \\ &= 80 + 12 \\ &= 102 \end{aligned}$$

WRITTEN CALCULATIONS

The following is a suggested progression through written calculation strategies.

- work on practical problem-solving activities involving equal groups.

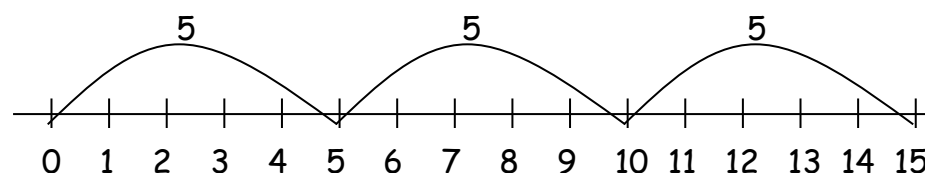


- develop an understanding of multiplication and use jottings to support calculation:
- use repeated addition

3×5 is $5 + 5 + 5 = 15$ or 3 lots of 5 or 5 groups of 3

- this can be shown easily on a number line:

$$5 \times 3 = 5 + 5 + 5$$



- use arrays
- model a multiplication calculation using an array

$$\begin{array}{ccccc} \bigcirc & \bigcirc & \bigcirc & \bigcirc & \bigcirc \\ \bigcirc & \bigcirc & \bigcirc & \bigcirc & \bigcirc \\ \bigcirc & \bigcirc & \bigcirc & \bigcirc & \bigcirc \end{array} \quad 5 \times 3 = 15$$

$$3 \times 5 = 15$$

- develop an understanding of **scaling**

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



5 cm



20 cm

- use symbols to stand for unknown numbers to complete equations using inverse operations

$$\square \times 5 = 20$$

$$3 \times \square = 18$$

$$\square \times 8 = 32$$

- use partitioning

$$\begin{aligned} 38 \times 5 &= (30 \times 5) + (8 \times 5) \\ &= 150 + 40 \\ &= 190 \end{aligned}$$

- use a grid method

TO x O Multiply a two-digit number by a single digit, e.g. 23×8

Children will approximate first: 23×8 is approximately $25 \times 8 = 200$

x	20	3	
8	160	24	

$$\begin{array}{r} 160 \\ + 24 \\ \hline 184 \end{array}$$

HTO x O Multiply a three-digit number by a single digit, e.g. 346×9

Children will approximate first: 346×9 is approximately $350 \times 10 = 3500$

x	300	40	6	
9	2700	360	54	

$$\begin{array}{r} 2700 \\ + 360 \\ + 54 \\ \hline 3114 \\ \hline \end{array}$$

TO x TO ('Long' multiplication – multiplication by more than a single digit)

$$72 \times 38$$

Children will approximate first

72×38 is approximately $70 \times 40 = 2800$

x	70	2
30	2100	60
8	560	16

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. 4.9×3

Children will approximate first

4.9×3 is approximately $5 \times 3 = 15$

x	4	0.9
3	12	2.7

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

HTO x TO ('Long' multiplication – multiplication by more than a single digit)

372×24

Children will approximate first

372×24 is approximately $400 \times 25 = 10000$

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

$$\begin{array}{r} 6000 \\ + 1400 \\ + 1200 \\ + 280 \\ + 40 \\ + 8 \\ \hline 8928 \\ 1 \end{array}$$

HTO x O Formal method (expanded)

The standard method of multiplication is a shorthand of the grid method. Moving from the grid method to the standard method is easier when the children can recognise the links between the two methods.

583

x 7

3500 (500 x 7)

560 (80 x 7)

+ 21 (3 x 7)

4081

HTO x O Formal method (compact)

$$\begin{array}{r} 583 \\ \times 7 \\ \hline 4081 \\ 352 \end{array}$$

TO x TO Formal method (expanded)

$$\begin{array}{r} 24 \\ \times 16 \\ \hline 240 \quad (24 \times 10) \\ + 144 \quad (24 \times 6) \\ \hline 384 \end{array}$$

TO x TO Formal method (compact)

$$\begin{array}{r} 24 \\ \times 16 \\ \hline 240 \\ + 144 \\ \hline 384 \end{array}$$

HTO x TO Formal method (compact)

$$\begin{array}{r} 124 \\ \times 26 \\ \hline 2480 \\ + 744 \\ \hline 3224 \\ 11 \end{array}$$

$$\begin{array}{r} 124 \\ \times 26 \\ \hline 744 \\ + 2480 \\ \hline 3224 \\ 11 \end{array}$$

$$\begin{array}{r} 372 \\ \times 24 \\ \hline 14288 \\ \underline{7440} \\ 8928 \\ 1 \end{array}$$

Start with a '0' as
you're multiplying
by a number in the
tens column

PROGRESSION THROUGH CALCULATIONS FOR DIVISION

MENTAL CALCULATIONS

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

Doubling and halving

Knowing that halving is dividing by 2

Deriving and recalling division facts

Activities related to times tables form a regular part of the mathematics lessons from KS1 upwards. As children make progress with multiplication concepts, so division facts can be derived from these.

Using and applying division facts

Utilise tables knowledge to derive other facts.

e.g. If I know $24 \div 8 = 3$, what else do I know?

$24 \div 3 = 8$, $240 \div 8 = 30$, $240 \div 3 = 80$, $2.4 \div 0.3 = 8$ etc

Dividing by 10 or 100

Know that the effect of dividing by 10 is a shift in the digits one place to the right.

Know that the effect of dividing by 100 is a shift in the digits two places to the right.

Use related facts

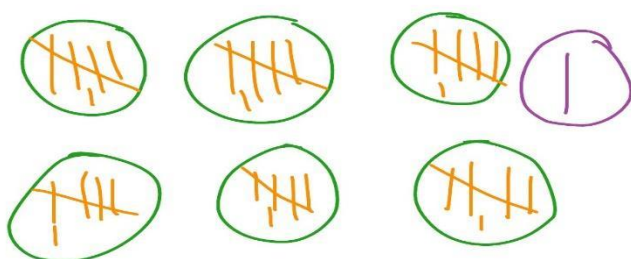
Given that $1.4 \times 1.1 = 1.54$

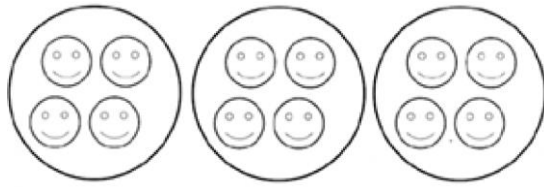
What is $1.54 \div 1.4$, or $1.54 \div 1.1$?

WRITTEN CALCULATIONS

The following is a suggested progression through written calculation strategies.

- use and understand equal groups and share items out in play and problem solving.

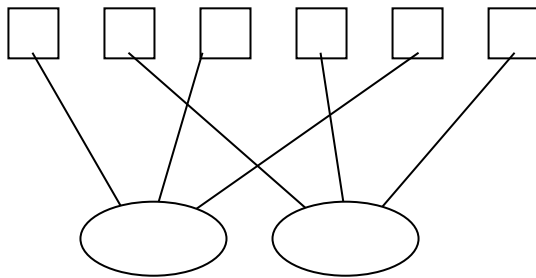




- develop an understanding of division, using jottings for support

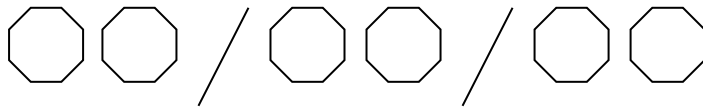
i) Sharing equally

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



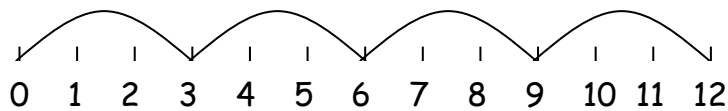
ii) Grouping or repeated subtraction

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



iii) Repeated subtraction using a number line

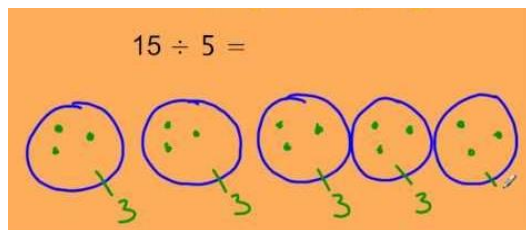
$$12 \div 3 = 4$$



- use arrays to solve division calculation

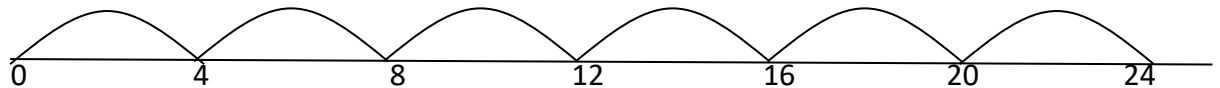
○ ○ ○ ○ ○	
○ ○ ○ ○ ○	$15 \div 3 = 5$
○ ○ ○ ○ ○	

$15 \div 5 = 3$



- use an empty number line

$$24 \div 4 = 6$$

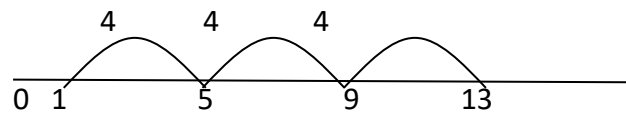


- use symbols to stand for unknown numbers to complete equations using inverse operations

$$\begin{array}{ll} \div 2 = 4 & 20 \div \blacksquare = 4 \\ 4 \times 2 = 8 & 20 \div 4 = 5 \end{array}$$

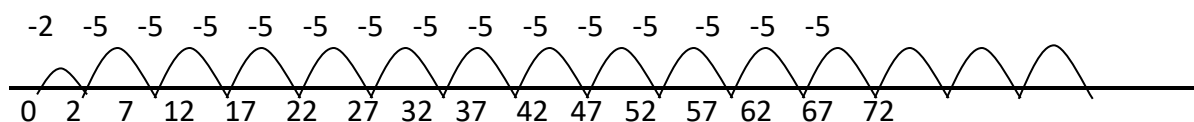
- solve calculations involving remainders

$$13 \div 4 = 3 \text{ r } 1$$



- develop the use of repeated subtraction to subtract multiples of the divisor (initially these should be multiples of 10s, 5s, 2s and 1s)

$$72 \div 5$$

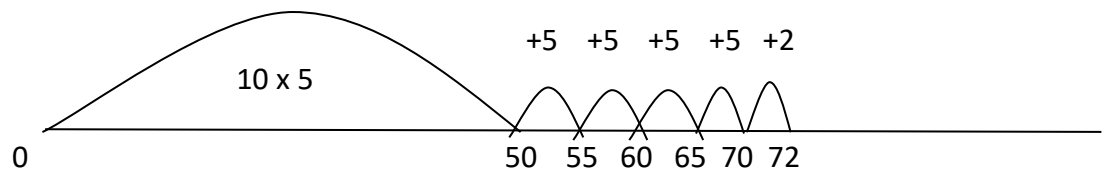


- use repeated addition (counting up) to show the inverse operation between multiplication and division.

$$+5 \quad +5 \quad +5 \quad +5 \quad +5 \quad +5 \quad +5 \quad +5 \quad +5 \quad +5 \quad +5 \quad +5 \quad +5 \quad +5 \quad +2$$



moving onto :



then onto the vertical method:

$72 \div 3$

$72 \div 3$

$$\begin{array}{r}
 3 \overline{) 72} \\
 \underline{- 30} \quad 10x \\
 42 \\
 \underline{- 30} \quad 10x \\
 12 \\
 \underline{- 6} \quad 2x \\
 6 \\
 \underline{- 6} \quad 2x \\
 0
 \end{array}$$

Answer : 24

$96 \div 6$

$$\begin{array}{r}
 6 \overline{) 96} \\
 \underline{- 60} \quad 10x \\
 36 \\
 \underline{- 36} \quad 6x \\
 0
 \end{array}$$

Answer : 16

Any 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 and round up or down accordingly. They should make sensible decisions about rounding up or down after division. For example $62 \div 8$ 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?

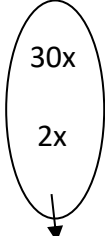
Answer: 7 (the remaining 6p is not enough to buy another sweet)

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)

HTO \div O, subtracting (or 'chunking') larger multiples of the divisor

$$196 \div 6$$

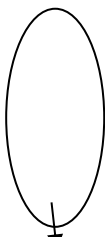
$$\begin{array}{r} 32 \text{ r } 4 \\ 6 \overline{) 196} \\ \underline{- 180} \\ 16 \\ \underline{- 12} \\ 4 \end{array}$$


Answer : 32 remainder 4 or 32 r 4

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

HTO \div TO

$$972 \div 36$$

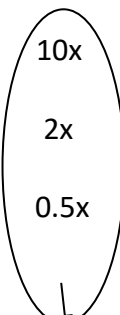
$$\begin{array}{r} 27 \\ 36 \overline{) 972} \\ \underline{- 720} \\ 252 \\ \underline{- 252} \\ 0 \end{array}$$


Answer : 27

Any remainders should be shown as fractions, i.e. if the children were dividing 32 by 10, the answer should be shown as $3 \frac{2}{10}$ which could then be written as $3 \frac{1}{5}$ in its lowest terms.

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

$$87.5 \div 7$$

$$\begin{array}{r} 12.5 \\ 7 \overline{) 87.5} \\ \underline{- 70.0} \\ 17.5 \\ \underline{- 14.0} \\ 3.5 \\ \underline{- 3.5} \\ 0 \end{array}$$


Answer : 12.5

Formal methods of short division:

$$\begin{array}{r} 14 \\ 7 \overline{) 98} \end{array}$$

Answer: 14

$$\begin{array}{r} 86 \text{ r } 2 \\ 5 \overline{) 432} \end{array}$$

Answer: 86 remainder 2

$$\begin{array}{r} 45 \text{ r } 3 \\ 11 \overline{) 498} \end{array}$$

Answer: $45 \frac{3}{11}$

Formal methods of long division:

$$\begin{array}{r} 28 \text{ r } 12 \\ 15 \overline{) 432} \\ - 300 \\ \hline 132 \\ - 120 \\ \hline 12 \end{array}$$

Answer: 28 remainder 12

$$\begin{array}{r} 28 \\ 15 \overline{) 432} \\ - 300 \quad (15 \times 20) \\ \hline 132 \\ - 120 \quad (15 \times 8) \\ \hline 12 \end{array}$$

$$\frac{12}{15} = \frac{4}{5}$$

Answer: $28 \frac{4}{5}$

$$\begin{array}{r} 28.8 \\ 15 \overline{) 432.0} \\ - 30 \downarrow \\ \hline 132 \\ - 120 \\ \hline 120 \\ - 120 \\ \hline 0 \end{array}$$

Answer: 28.8

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

Children should be encouraged to approximate their answers before calculating and use checking strategies to see that their answers are reasonable.

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