Wroxall Primary School

Learning Together

Castle Road, Wroxall, IW PO38 3DP

Tel. 01983 852290

office@wroxallprimary.co.uk

Calculation Policy
January 2022

This policy was adopted and agreed by the Governing Board on

It is due for review in January 2024.

Signature Headteacher Date: 04.01.22

Signature Chair of Governors Date:

All the governors and staff of Wroxall Primary School are committed to sharing a common objective to help keep the children and staff of the school community safe. We ensure that consistent effective safeguarding procedures are in place in order to support families, children and staff of the school.

Revision Record

Revision No.	Date Issued	Prepared By	Approved	Comments
1	December 2020	LT and BP	FGB	Update to the previous policy to show a change in methods/calculations.
2	January 2022	B.S.	FGB	Minor adaptations
3				
4				

The maths that your child does at school may look very different to the kind of ‘calculations’ that you remember.

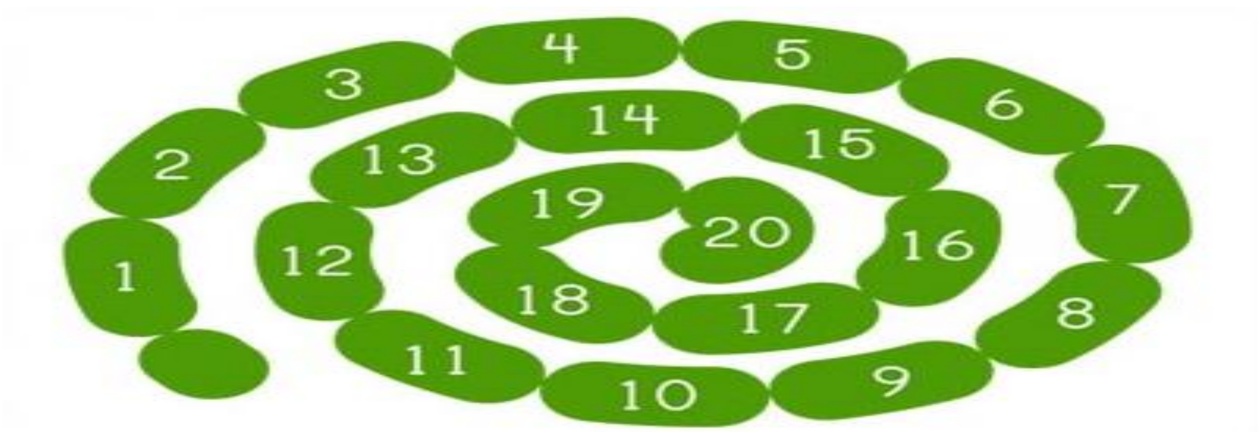
This policy is designed as a guide to how calculation methods and strategies are taught in school and the progression of skills that are developed.
From nursery right through to the end of Year 6, children are developing a range of calculation methods. These may be pictorial, practical, oral and mental (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	☐ + 3 = 10
25 + 75 = 100	19 + ☐ = 20

Use near doubles
6 + 7 = 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 (by counting on in tens and then in ones)
(80 + 50) + (6 + 7) = 143

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

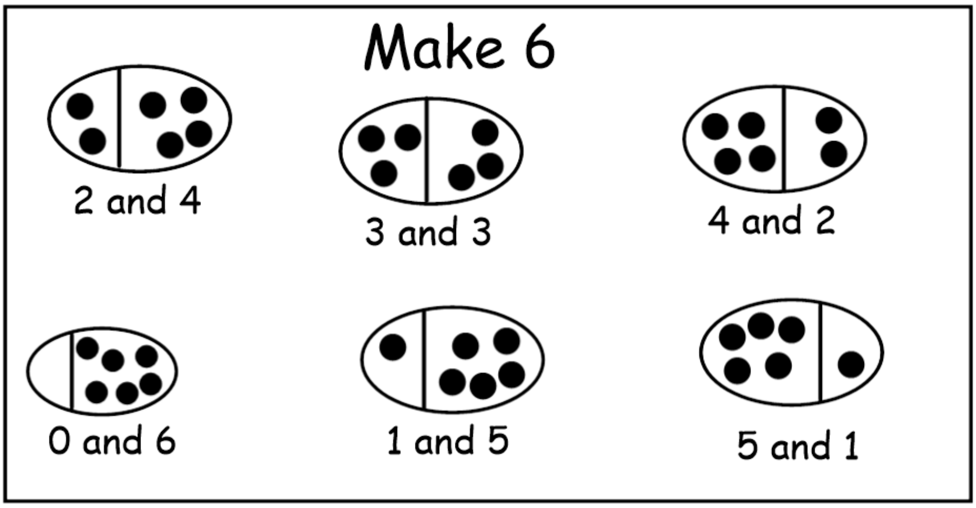
36 + 19 = 55	19 + 36 = 55
55 – 19 = 36	55 – 36 = 19

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

WRITTEN CALCULATIONS

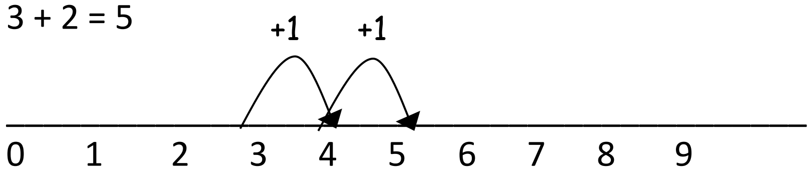
The following is a suggested progression through written calculation strategies.

- 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



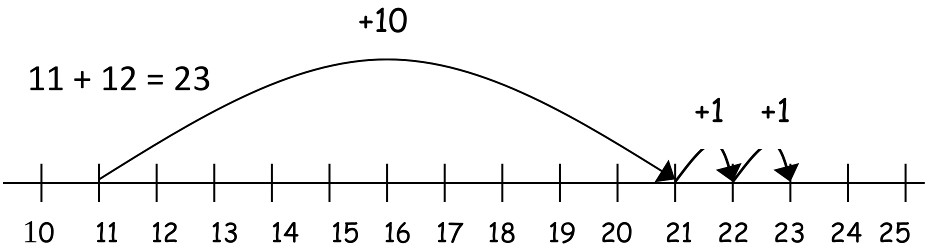
- use number lines to support calculations, initially counting on in ones

3 + 2 = 5



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

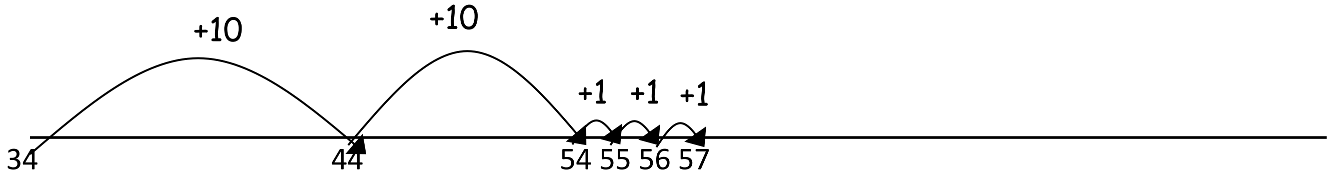
11 + 12 = 23



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

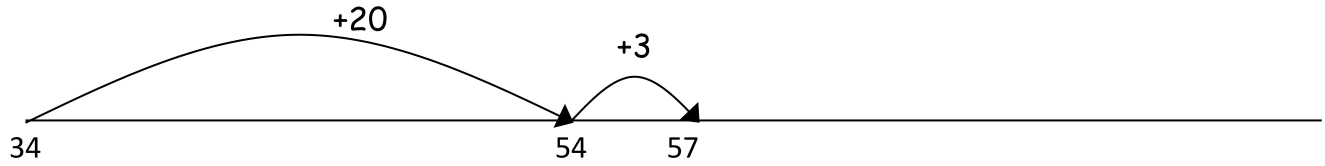
i) counting on in tens and ones.

34 + 23 = 57



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

34 + 23 = 57



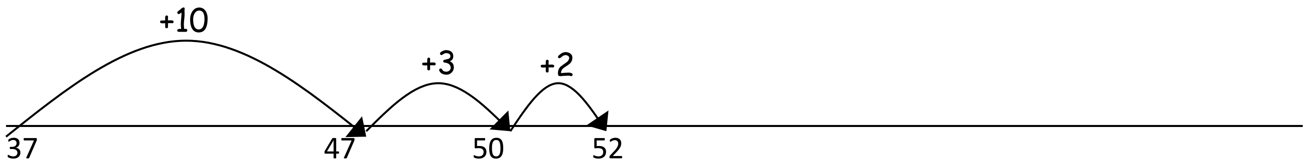
iii) use jottings to record calculations

34 + 23 = 57

30 + 20 = 50 → 4 + 3 = 7 → 50 + 7 = 57

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

37 + 15 = 52

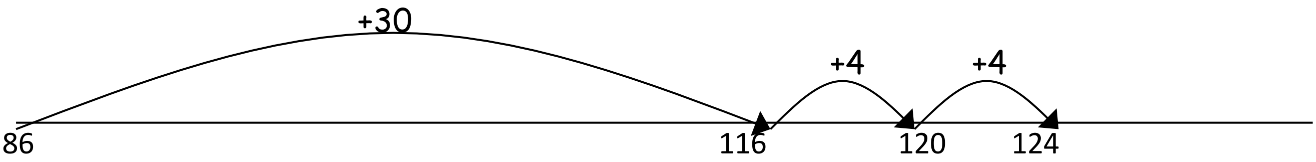


37 + 15 = 52

30 + 10 = 40 → 7 + 5 = 12 → 40 + 12 = 52

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

38 + 86 = 124

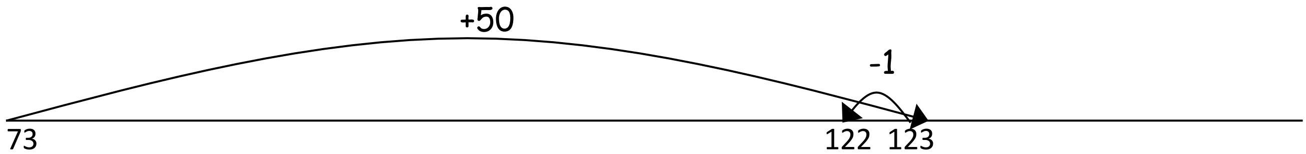


38 + 86 = 124

86 + 30 = 116 → 116 + 8 = 124

- use ‘compensation’ when adding numbers

49 + 73 = 122



73 + 50 = 123 → 123 – 1 = 122

- arrange numbers vertically, adding the most significant digits first

```
   67
 + 24
   80   (60 + 20)
   1 1  ( 7 +  4)
   9 1
```

```
   267
 +  85
   200
   140  (60 + 80)
    12  ( 7 +  5)
   352
```

- add the least significant digits first in preparation for ‘exchanging’.

```
    67                          267
 +  24                       +   85
   1 1  ( 7 +  4)                12  ( 7  +  5)
    80  (60 + 20)               140  (60 + 80)
   9 1                          200
                                352
```

- add numbers vertically using ‘exchanging’

```
   625          783         367
 +  48        +  62       + 585
   673          845         952
    1           1           1 1
```

- perform addition with any number of digits, including decimals

```
   7648          6584         16.3
 + 1486        + 5848       + 6.47
   9134         12432        22.77
  1 1 1         1 1 1        1
```

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 - ☐ = 11
20 - 17 = 3	10 - ☐ = 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 (by counting back in tens and then in ones)

86 - 52 = 34

86 - 50 = 36

36 - 2 = 34

460 - 300 = 160 (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

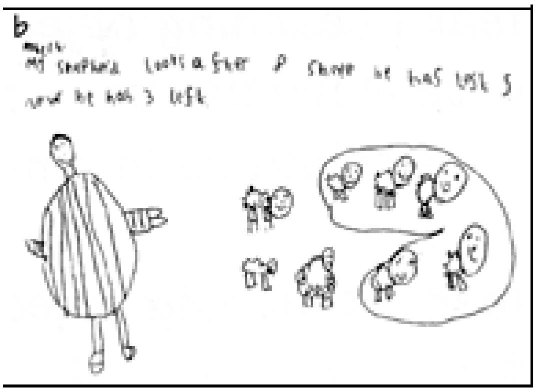
36 + 19 = 55	19 + 36 = 55
55 – 19 = 36	55 – 36 = 19

MANY MENTAL CALCULATION STRATEGIES WILL CONTINUE TO BE USED ALONGSIDE WRITTEN METHODS

WRITTEN CALCULATIONS

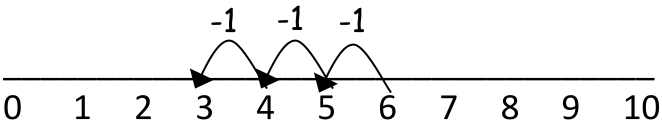
The following is a suggested progression through written calculation strategies.

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

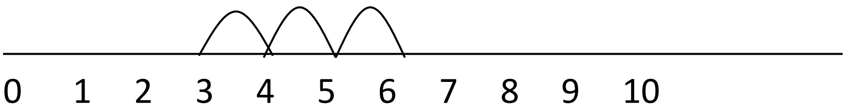


- use number lines and practical resources to support calculation, initially counting back in ones.

6 – 3 = 3

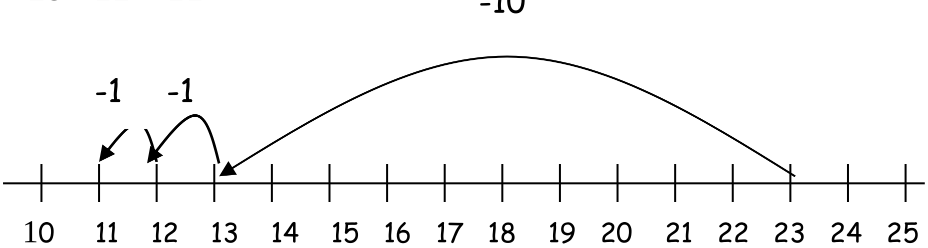


- use number lines to show that 6 - 3 means the ‘difference between 6 and 3’ or ‘the difference between 3 and 6’ and how many jumps they are apart.



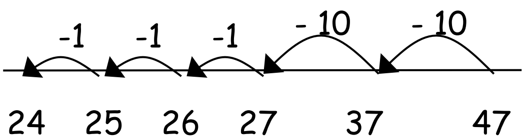
- count back in tens and ones with the aid of a number line

23 - 12 = 11



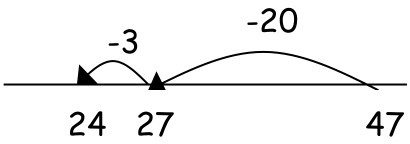
- use empty number lines to support calculations, counting back in tens and ones

47 – 23 = 24



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

47 – 23 = 24

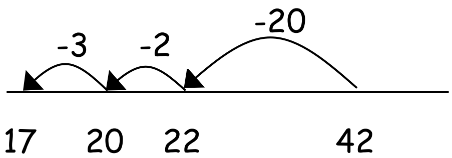


47 – 23 = 24

40 – 20 = 20 → 7 – 3 = 4 → 20 + 4 = 24

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

42 – 25 = 17

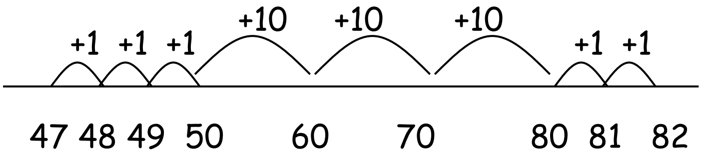


42 – 25 = 17

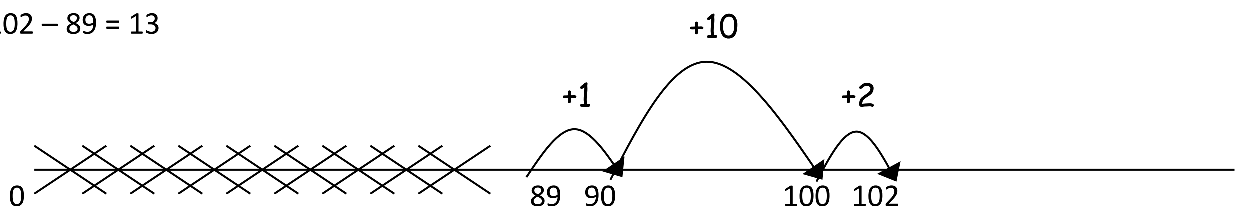
42 - 20 = 22 → 22 – 5 = 17

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

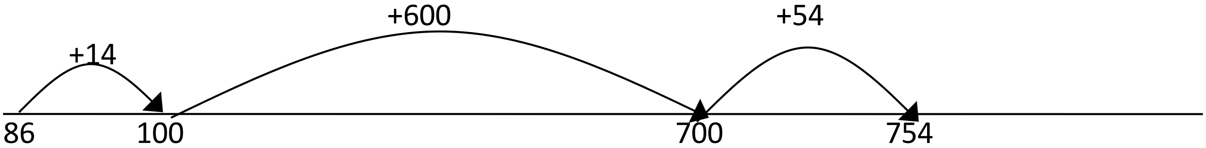
82 – 47 = 35



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

$$
\begin{array}{rrr}
 & 80 \text{ and } 9 & \\
- & \underline{50 \text{ and } 7} & \\
 & \underline{30 \text{ and } 2} & = 32
\end{array}
$$

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

71 - 46

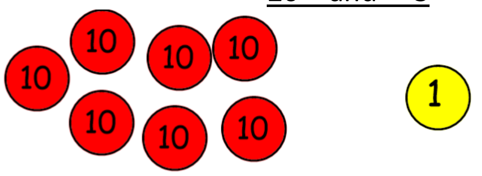
Step 1

$$
\begin{array}{rr}
 & 70 \text{ and } 1 \\
- & \underline{40 \text{ and } 6} \\
 & \underline{\qquad\qquad}
\end{array}
$$

As 1-6 is not possible, an exchange is needed.

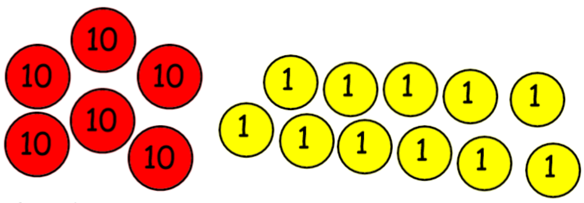
Step 2

$$
\begin{array}{rrr}
 & 60 \text{ and } 11 & \\
- & \underline{40 \text{ and } 6} & \\
 & \underline{20 \text{ and } 5} & = 25
\end{array}
$$



'Take away 4 tens' 'Take away 6 ones'

'But there aren't 6 ones. We will have to exchange.'



After changing 1 ten into 10 ones.

'Take away 4 tens' 'Take away 6 ones'

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

$$
\begin{array}{rr}
 & {}^{6}\cancel{7}\ {}^{1}1 \\
- & \underline{4\ \ 6} \\
 & \underline{2\ \ 5}
\end{array}
$$

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

754 - 286

Step 1

$$\begin{array}{rrrrrr} & 700 & + & 50 & + & 4 \\ - & \underline{200} & \underline{+} & \underline{80} & \underline{+} & \underline{6} \end{array}$$

Step 2 *(adjust from T to O)*

$$\begin{array}{rrrrrr} & 700 & + & 40 & + & 14 \\ - & \underline{200} & \underline{+} & \underline{80} & \underline{+} & \underline{6} \end{array}$$

Step 3 *(adjust from H to T)*

$$\begin{array}{rrrrrrrr} & 600 & + & 140 & + & 14 & & \\ - & \underline{200} & \underline{+} & \underline{80} & \underline{+} & \underline{6} & & \\ & 400 & + & 60 & + & 8 & = & 468 \end{array}$$

recorded as

$$\begin{array}{rrrrrrrr} & \overset{600}{700} & + & \overset{140}{\cancel{50}} & + & {}^{1}4 & & \\ - & \underline{200} & \underline{+} & \underline{80} & \underline{+} & \underline{6} & & \\ & 400 & + & 60 & + & 8 & = & 468 \end{array}$$

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

$$\begin{array}{rr} & \overset{6}{\cancel{7}}\overset{14}{\cancel{5}}\overset{1}{}4 \\ - & \underline{286} \\ & \underline{468} \end{array}$$

- perform subtraction with any number of digits, including decimals

$$\begin{array}{rr} & \overset{5}{\cancel{6}}\overset{13}{\cancel{4}}\overset{1}{6}7 \\ - & \underline{2684} \\ & \underline{3783} \end{array} \qquad \qquad \begin{array}{rr} & \mathbf{\overset{8}{5}\overset{1}{\cancel{9}}.52} \\ - & \mathbf{\underline{23.7\ }} \\ & \mathbf{\underline{25.82}} \end{array}$$

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 x 4 is double 4 x 4

Commutativity
Children should know that 3 x 5 has the same answer as 5 x 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 x 12.
By the end of Year 6, they should also be able to derive and recall quickly related division facts up to 12 x 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 x 7 = 21, what else do I know?
30 x 7 = 210, 300 x 7 = 2100, 3000 x 7 = 21 000, 0.3 x 7 = 2.1 etc

Use closely related facts already known
13 x 11 = (13 x 10) + (13 x 1)
= 130 + 13
= 143

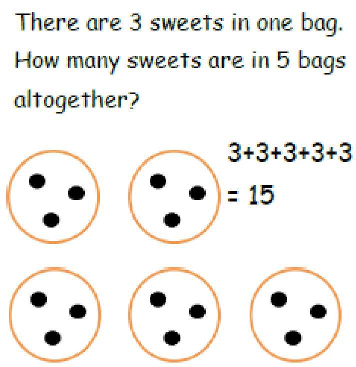
Multiplying by 10 or 100
Knowing that the effect of multiplying by 10 is a shift in the digits one place to the left.
Knowing that the effect of multiplying by 100 is a shift in the digits two places to the left.

Partitioning
23 x 4 = (20 x 4) + (3 x 4)
= 80 + 12
= 102

WRITTEN CALCULATIONS

The following is a suggested progression through written calculation strategies.

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



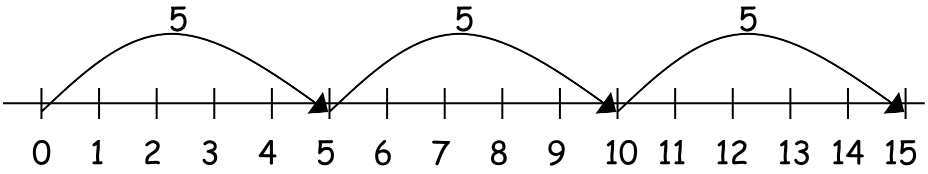
- develop an understanding of multiplication and use jottings to support calculation:

- **use repeated addition**

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

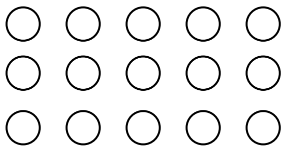
- this can be shown easily on a number line:

3 x 5 = 5 + 5 + 5



- **use arrays**

- model a multiplication calculation using an array

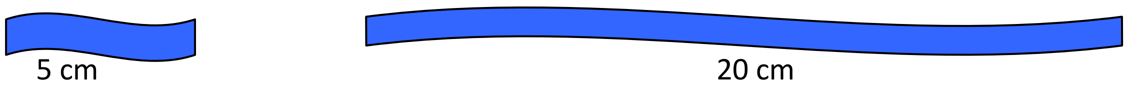


5 x 3 = 15

3 x 5 = 15

- develop an understanding of s**caling**

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



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

☐ x 5 = 20 3 x △ = 18 ☐ x 8 = 32

- **use partitioning**

38 x 5 = (30 x 5) + (8 x 5)
= 150 + 40
= 190

- **use a grid method**

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

Children will approximate first: 23 x 8 is approximately 25 x 8 = 200

x	20	3
8	160	24

160
+ 24

184

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

Children will approximate first: 346 x 9 is approximately 350 x 10 = 3500

x	300	40	6
9	2700	360	54

```
   2700
+   360
+    54
   3114
    1 1
```

Long multiplication – multiplication by more than a single digit

72 x 38

Children will approximate first
72 x 38 is approximately 70 x 40 = 2800

x	70	2
30	2100	60
8	560	16

```
   2100
+   560
+    60
+    16
   2736
    1
```

Using similar methods, children 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

```
    12
+    2.7
    14.7
```

Long multiplication – multiplication by more than a single digit

372 x 24

Children will approximate first
372 x 24 is approximately 400 x 25 = 10000

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

```
  6000
+ 1400
+ 1200
+  280
+   40
+    8
  8928
   1
```

Formal multiplication 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
```

Formal method (compact)

```
 583
x  7
4081
 352
```

Formal method (expanded)

```
  24
x 16
 240  (24 x 10)
+144  (24 x 6)
```

384

Formal method (compact)

24
x 16
240
+ 144
384

HTO x TO Formal method (compact)

124	124	3 7 2
x 26	x 26	x 2 4
2480	744	1 4 2 8 8
+ 744	+ 2480	7 1 4 4 0
3224	3224	8 9 2 8
1 1	1 1	1

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 ÷ 8 = 3, what else do I know?
24 ÷ 3 = 8, 240 ÷ 8 = 30, 240 ÷ 3 = 80, 2.4 ÷ 0.3 = 8 etc

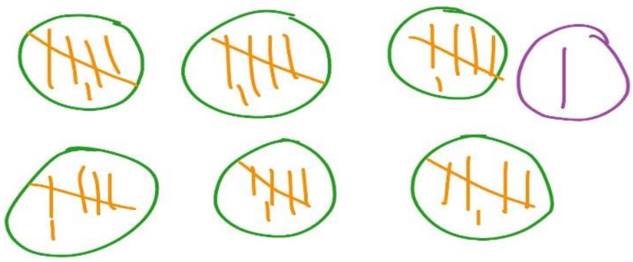
Dividing by 10 or 100
Know that the effect of dividing by 10 is a shift in the digits one place to the right.
Know that the effect of dividing by 100 is a shift in the digits two places to the right.

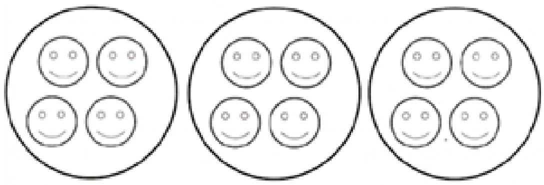
Use related facts
Given that 1.4 x 1.1 = 1.54
What is 1.54 ÷ 1.4, or 1.54 ÷ 1.1?

WRITTEN CALCULATIONS

The following is a suggested progression through written calculation strategies.

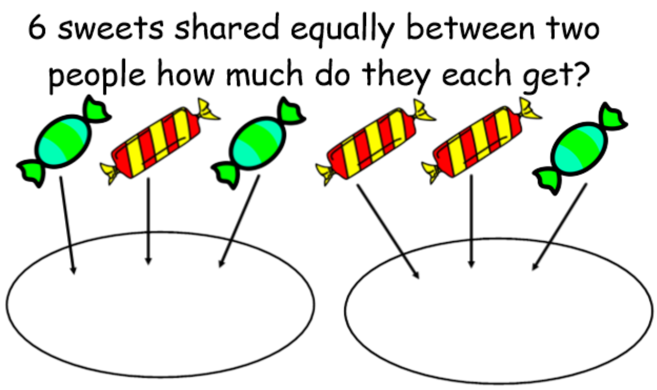
- use and understand equal groups and share items out in play and problem solving.





- develop an understanding of division, using jottings for support

i)**Sharing equally**

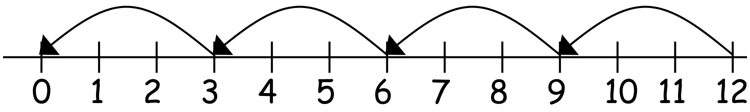


ii)Grouping or repeated subtraction

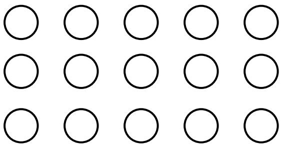
There are 6 sweets, how many people can have 2 sweets each?

iii)Repeated subtraction using a number line

12 ÷ 3 = 4

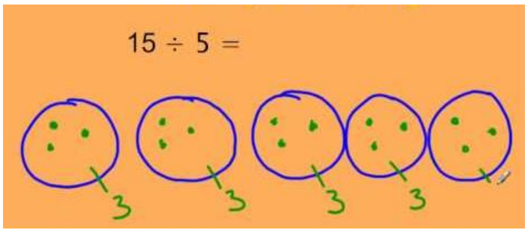


- **use arrays** to solve division calculation



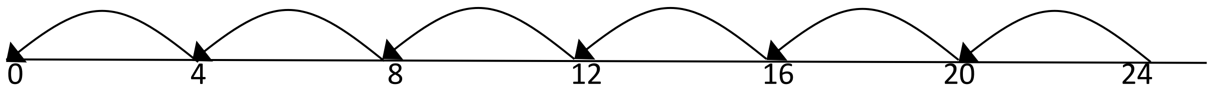
15 ÷ 3 = 5

15 ÷ 5 = 3



- **use an empty number line**

24 ÷ 4 = 6



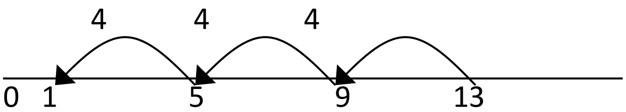
- **use symbols to stand for unknown numbers to complete equations using inverse operations**

☐ ÷ 2 = 4   20 ÷ △ = 4

4 x 2 = 8   **20** ÷ 4 = 5

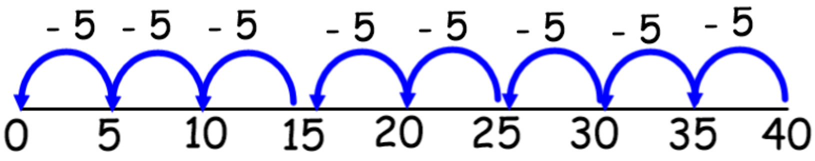
- solve calculations involving remainders

13 ÷ 4 = 3 r 1

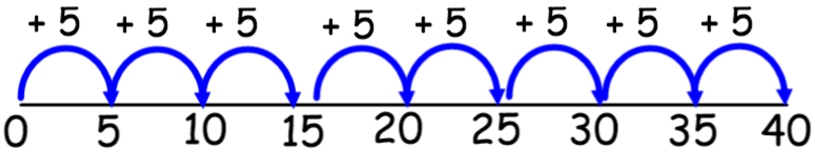


- develop the use of repeated subtraction to subtract multiples of the divisor (initially these should be multiples of 10s, 5s, 2s and 1s)

40 ÷ 5



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



Then onto the vertical method:

2 digits ÷ 1 digit

72 ÷ 3

3)72
(30÷3 = 10)
42
(30÷3 = 10)
12÷3 = 4
24

96 ÷ 6

6)96
(60÷6 = 10)
36÷6 = 6
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 ÷ 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)

3 digits ÷ 1 digit, subtracting (or 'chunking') larger multiples of the divisor

196 ÷ 6

```
       32 r 4
  6 )  196
    -  180      x30
        16
    -   12      x2
     4
```

Answer : 32 remainder 4 or 32 r 4

Any remainders should be shown as integers, i.e. 32 remainder 4 or 32 r 4.

3 digits ÷ 2 digits

972 ÷ 36

```
      27
  36 ) 972
     -  720      X20
        252
     -  252      X7
          0
```

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 $3\,{}^{2}/_{10}$ which could then be written as $3\,{}^{1}/_{5}$ 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 ÷ 7

```
       12.5
  7 )  87.5
    -  70.0     X10
       17.5
    -  14.0     X2
        3.5
    -   3.5     X 0.5
     0
```

Answer : 12.5

Formal methods of short division:

$$\begin{array}{r} 1\;\;4 \\ 7\,\overline{)\,9\;{}^{2}8} \end{array}$$

Answer: 14

$$\begin{array}{r} 8\;\;6\;\;\;r\;2 \\ 5\,\overline{)\,4\;\;3\;{}^{3}2} \end{array}$$

Answer: 86 remainder 2

$$\begin{array}{r} 4\;\;5\;\;\;r\;3 \\ 11\,\overline{)\,4\;\;9\;{}^{5}8} \end{array}$$

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

Formal methods of long division:

$$\begin{array}{r} 28\;\;\;\;r\;12 \\ 15\,\overline{)\,432} \\ -\;\underline{300} \\ 132 \\ -\;\underline{120} \\ 12 \end{array}$$

Answer: 28 remainder 12

$$\begin{array}{rl} 28 & \\ 15\,\overline{)\,432} & \\ -\;\underline{300} & (15 \times 20) \\ 132 & \\ -\;\underline{120} & (15 \times 8) \\ 12 & \end{array}$$

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

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

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

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.