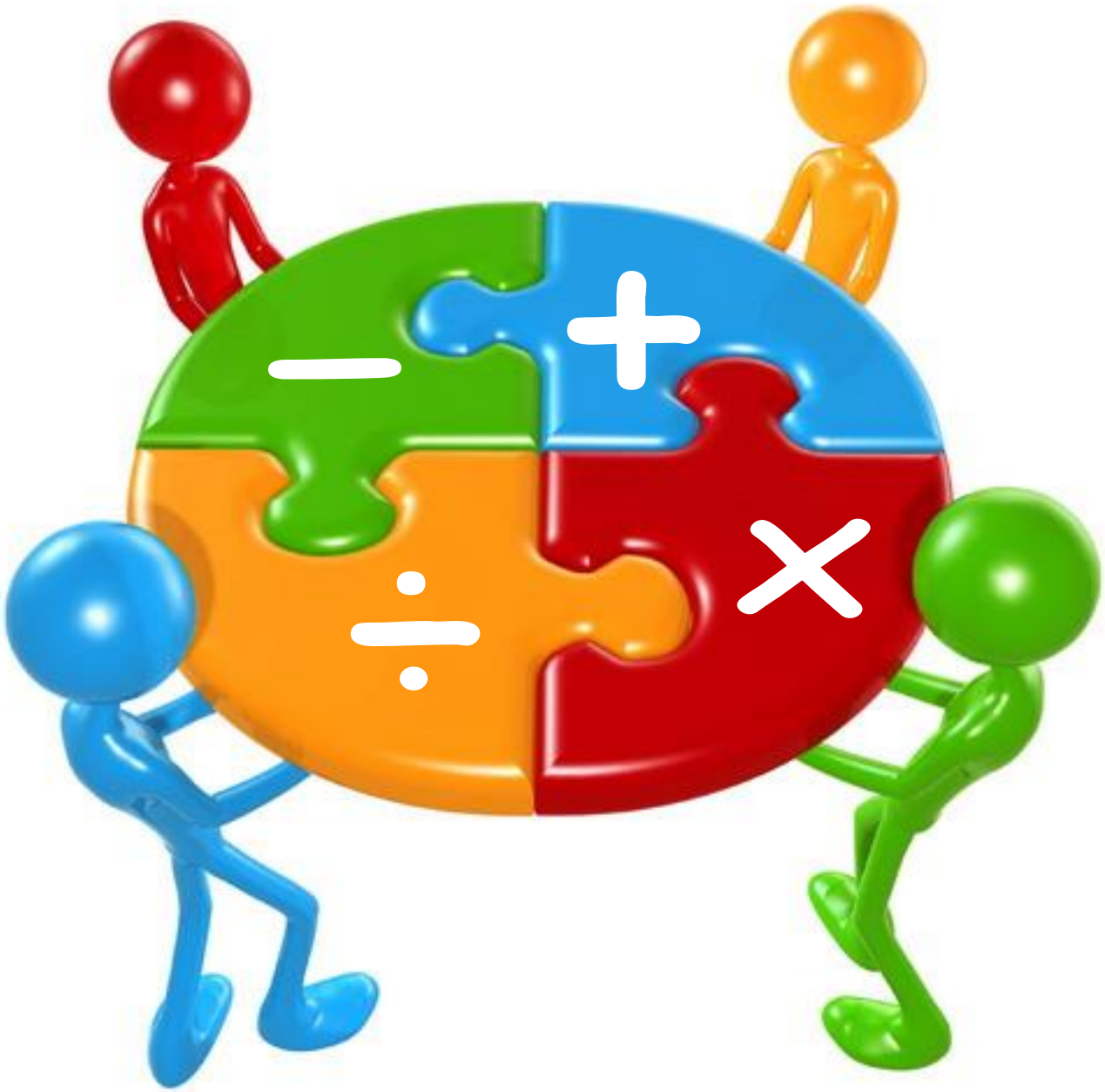
Stockton Wood Primary School

Calculation Policy



Stockton Wood Primary School

Calculation Policy

This policy has been developed to ensure continuity and progression of the teaching and learning of calculations. Staff should use the strategies for their year group where appropriate as this should follow on from previous learning and lead in to future learning. Some children will need to use earlier steps; some will be ready to move on quickly. Provided the children's understanding and confident use of each strategy is secure, this is not a problem.

The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use an efficient written method accurately and with confidence.

Progressing from mental to written methods

1. Establish mental methods, based on a good understanding of place value.
2. Present calculations in a horizontal format.
3. Show children how to set out written calculations vertically, initially using expanded layouts that record their mental methods.
4. As children become more confident, refine the written record into a more compact method.
5. Extend to larger numbers and to decimals. (Children may initially need to return to a more expanded layout.)

Questions all pupils should ask themselves:

- Can I do it in my head?
- Can I do it in my head but with jottings so that I don't get lost?
- Can I use an informal written method (such as a numberline) because the numbers are difficult for me to manage?
- Can I use a written method because the numbers are more complicated?
- Can I use a calculator because the numbers are unwieldy?

Addition

Written methods for addition

It is important that children's mental methods of calculation are practised on a regular basis and secured alongside their learning and use of written methods of addition.

The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use a written method accurately and with confidence.

Children are taught and acquire secure mental methods of calculation and one written method of calculation for addition which they know they can rely on when mental methods are not appropriate.

This policy shows the possible stages of each written method for addition, each stage building towards a more refined method.

There are some key basic skills that children need to help with addition, which include:

- Counting
  - forwards and backwards
  - count from different starting points
  - number word before and number word after (one less and one more)
  - ten before, ten after
  - count in different steps, different rhythms
- estimating
- recalling all addition **pairs** to 10, 20 and 100 (7 + 3 = 10, 17 + 3 = 20, 70 + 30 = 100)
- knowing number **facts** to 10 (6 + 2 = 8)
- adding mentally a series of one-digit numbers (5 + 8 + 4)
- adding multiples of 10 (60 + 70) or of 100 (600 + 700) using the related addition fact, 6 + 7, and their knowledge of place value
- partitioning two-digit and three-digit numbers into multiples of 100, 10 and 1 in different ways (432 into 400 + 30 + 2 and also into 300 + 120 + 12)
- understanding and using addition and subtraction as inverse operations
- place value/ understanding the number system (*where would this number go on a number line 0-100, 0-1000, 50-150, ... Tell me everything you know about this number)*

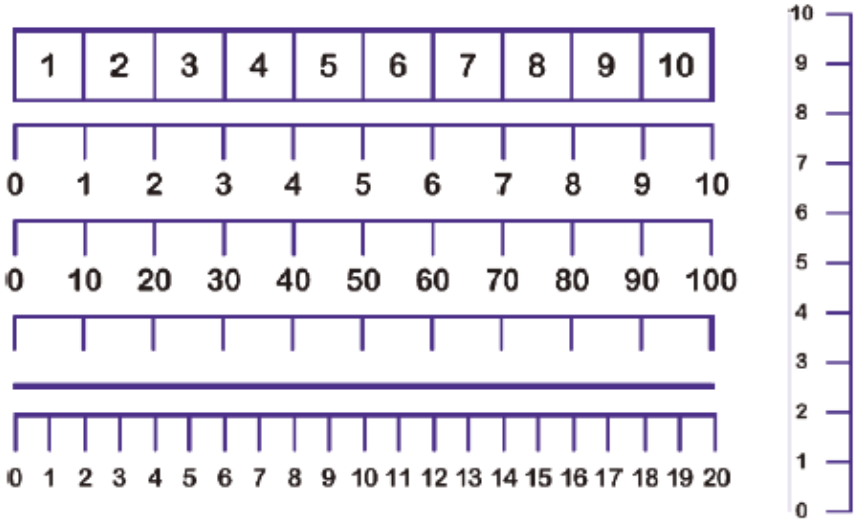
Using and applying is a key theme and one of the aims of National Curriculum and before children move onto the next stage in written calculation it is important that their skills are broadened through their use and application in a range of contexts, these include:

- using inverse
- missing box questions
- using units of measure including money and time
- word problems
- open ended investigations
- number sentences with equal sign (=) in different places

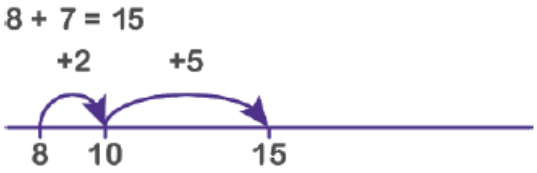
Stage 1: Practical (combining) and add on (increasing)

Prior to recording addition steps on a number line, children will work practically with equipment where they are **combining** sets of objects. As they become more confident, this practical addition of sets of objects will be mirrored on a number line so that the two are being done together and children are **adding on**. This will prepare them for the abstract concept of adding numbers rather than objects.

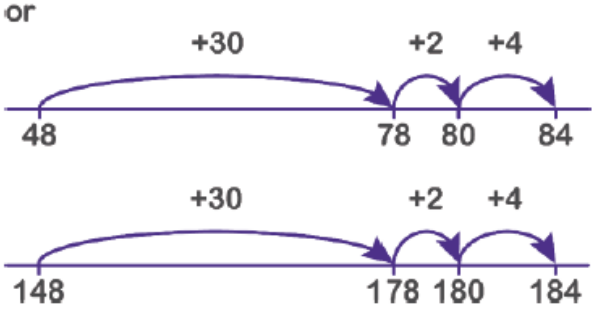
Stage 2: Number tracks and number lines



Steps in addition can be recorded on a number line. The steps often bridge through a multiple of 10 and, this is more efficient if children know how to partition 1-digit numbers.



In this example, 7 has been partitioned into 2 and 5 which makes bridging through 10 more efficient



In these examples, the 6 in 36 has been partitioned into 2 and 4 which makes bridging through 10 more efficient

With practice, children will need to record fewer jumps

Stage 3: Partitioning (expanded columnar method)

Partition both numbers into tens and units or hundreds, tens and units

48 + 36 = 84

	40	8	
+	30	6	
	70	14	84

148 + 36 = 184

	100	40	8	
+		30	6	
	100	70	14	184

This builds on children's mental maths skills of partitioning and recombining 40 + 30 = 70

8 + 6 = 14

70 + 14 = 84

48 + 36 = 84

To be modelled with Numicon and base ten apparatus

Then, in preparation for column method
This can be modelled by the class teacher before moving onto Stage 4

	T	U
	4	8
+	3	6
	1	4
	7	0
	8	4

	H	T	U
	1	4	8
+		3	6
		1	4
		7	0
	1	0	0
	1	8	4

Stage 4: Efficient (column method)

Language is "eight add six" and then both
"forty add thirty" and " four tens and three tens" when adding tens column

48	148	48.56
+ 36	+ 36	+ 32.23
84	184	80.79
1	1	1

Children should be encouraged to estimate their answers first.

Encourage pupils to cross out any tens or hundreds (or tenths, hundredths, etc) they've carried.

Column addition remains efficient when used with larger whole numbers or decimals, and when adding more than two numbers*, once learned, the method is quick and reliable.

Children need to have experience of adding more than two numbers, and experience carrying more than 1.

Children need to experience adding numbers with different decimal places so children have experience to set out correctly and line up the values (place value). 48.5 + 32.23

NOTES

Subtraction

Written methods for Subtraction

It is important that children's mental methods of calculation are practised on a regular basis and secured alongside their learning and use of written methods of subtraction.

The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use a written method accurately and with confidence.

Children are taught and acquire secure mental methods of calculation and one written method of calculation for subtraction which they know they can rely on when mental methods are not appropriate.

This policy shows the possible stages of each written method for subtraction, each stage building towards a more refined method.

There are some key basic skills that children need to help with subtraction, which include:

• counting

- forwards and backwards (to and from)
- count from different starting points
- number word before and number word after (one less and one more)
- ten before, ten after
- count in different steps, different rhythms

• estimating

• recalling all addition **pairs** to 10, 20 and 100 along with their inverses (7 + 3 = 10, 10 – 3 = 7, 17 + 3 = 20, 20 – 3 = 17, 70 + 30 = 100, 100 – 30 = 70)

• knowing number **facts** to 10 and their inverses (6 + 2 = 8, 8 - 2 = 6)

• subtracting multiples of 10 (160 - 70) using the related subtraction fact, 16 - 7, and their knowledge of place value

• partitioning two-digit and three-digit numbers into multiples of 100, 10 and 1 in different ways (432 into 400 + 30 + 2 and also into 300 + 120 + 12)

• understanding and using subtraction and addition as inverse operations

Using and applying is a key theme and one of the aims of National Curriculum and before children move onto the next stage in written calculation it is important that their skills are broadened through their use and application in a range of contexts, these include:

• using inverse

• missing box questions

• using units of measure including money and time

• word problems

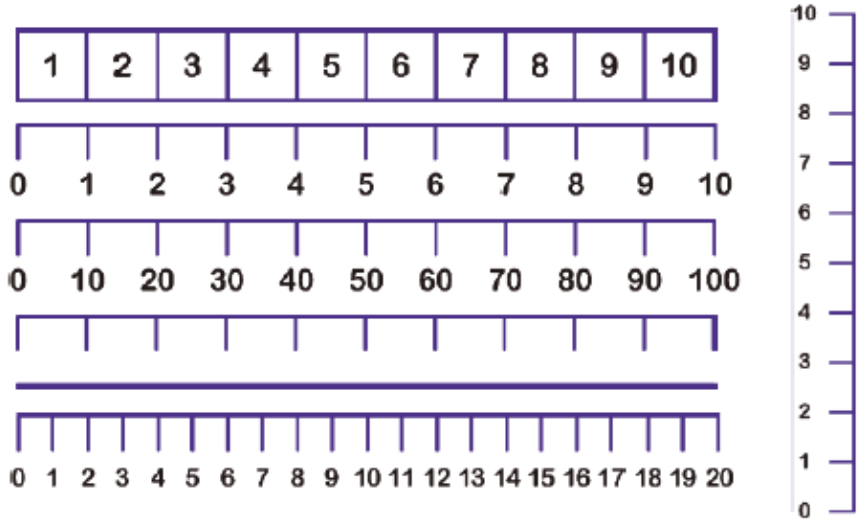
• open ended investigations

• number sentences with equal sign (=) in different places

Stage 1: Practical (taking away)

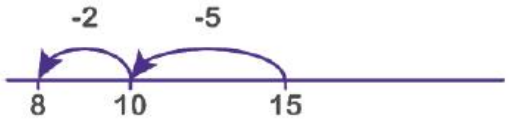
Prior to recording subtraction steps on a number line, children will work practically with equipment where they are 'taking away' a small group from a larger set of objects. As they become more confident, this practical subtraction will be mirrored on a number line so that the two are being done together. This will prepare them for the abstract concept of subtracting numbers rather than objects.

Stage 2: Number tracks and number lines



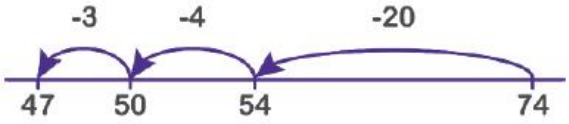
Counting back (to be introduced before counting up)
Steps in subtraction can be recorded from right to left on a number line. The steps often bridge through a multiple of 10 and, this is more efficient if children know how to partition 1-digit numbers.

15 - 7 = 8

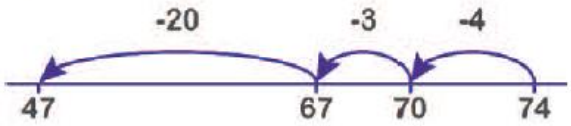


In this example, 7 has been partitioned into 2 and 5 which makes bridging through 10 more efficient

74 - 27 = 47



or



In these examples, 27 has been partitioned into tens and units then the 7 has been partitioned into 3 and 4 which makes bridging through 10 more efficient

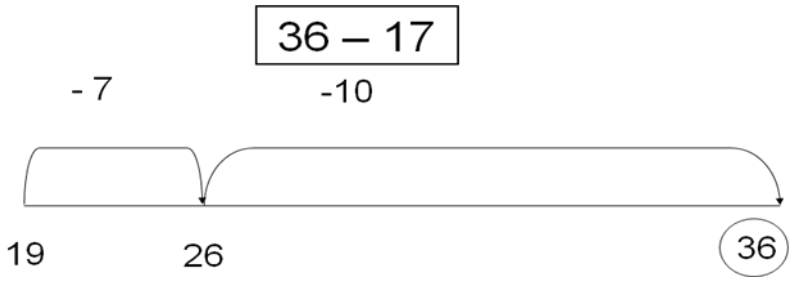
174 - 27 = 147

With practice, children will need to record fewer jumps

Counting down to or count down from:

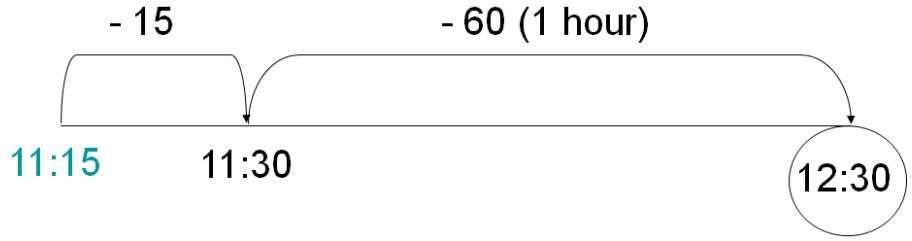
- 54 – 49 =
- 42 – 3 =
- 163 – 159 =
- 189 – 6 =

Counting back in steps



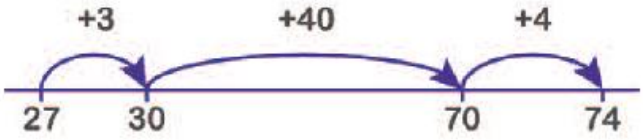
Transferring skills

John finished his run at 12:30pm he had been running for 1hr 15 minutes. What time did he start?



Counting up (to be introduced after counting back)

Steps in subtraction can be recorded from left to right on a number line. The steps often bridge through a multiple of 10.



or

When carrying out money calculations that involve finding change or when calculating time duration, children should use this method

With practice, children will need to record fewer jumps.

They will decide whether to count back or forwards, seeing both as 'finding the difference'. It is useful to ask children whether counting up or back is the more efficient for calculations such as 57 – 12 or 86 – 77.

Stage 3: Partitioning (expanded columnar method)

Partition both numbers into tens and units or hundreds, tens and units

74 - 27 = 47

60
~~70~~ 14
\+ 20 7
40 7 47

174 - 27 = 147

60
100 ~~70~~ 14
\+ 20 7
100 40 7 147

To be modelled with Numicon and base ten apparatus

Then, in preparation for column method

	T	U
	~~6~~ 7	14
-	2	7
		7

```
  4  0
  4  7
```

```
      H  T  U
         6  1
      1  7  4
+        2  7
------------
            7
         4  0
      1  0  0
------------
      1  4  7
```

Stage 4: Efficient (column method)

Language is “4 subtract 7”* and then both
“sixty subtract twenty” and “ six tens subtract two tens” when subtracting tens column

* take one of the tens and **exchange** it for ten units

```
    6  1
    7  4
-   2  7
-------
    4  7
```

```
      6  1
   1  7  4
-     2  7
----------
   1  4  7
```

```
   4  8 . 5
-  3  2 . 2
------------
   1  6 . 3
```

Children should be encouraged to estimate their answers first and decide whether it would be more efficient to do mentally.

Eg. 5005 – 198

2002 - 1995

Column subtraction remains efficient when used with larger whole numbers or decimals, once learned, the method is quick and reliable.

Give pupils numbers of different sizes eg. HTU – TU and different decimal places TU. t – TU.th (48.5 – 32.23) to experience correct layout for place value

NOTES

Multiplication

Written methods for Multiplication

It is important that children's mental methods of calculation are practised on a regular basis and secured alongside their learning and use of written methods of multiplication.

The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use a written method accurately and with confidence.

Children are taught and acquire secure mental methods of calculation and one written method of calculation for multiplication which they know they can rely on when mental methods are not appropriate.

This policy shows the possible stages of each written method for multiplication, each stage building towards a more refined method.

There are some key basic skills that children need to help with multiplication, which include:

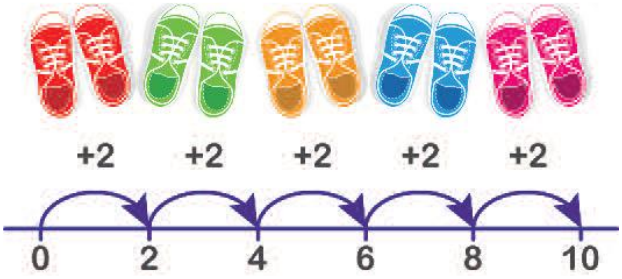
- Counting (step counting linking with multiplication)
- estimating
- understanding multiplication as repeated addition
- read and write the x sign
- understand multiplication as describing an array
- begin to recognise from arranging arrays that multiplication can be done in any order (commutative)
- recalling all multiplication facts to 12 × 12
- partitioning numbers into multiples of one hundred, ten and one
- working out products (70 × 5, 70 × 50, 700 × 5, 700 × 50) using the related fact 7 × 5 and their knowledge of place value
- adding two or more single-digit numbers mentally
- adding multiples of 10 (60 + 70) or of 100 (600 + 700) using the related addition fact, 6 + 7, and their knowledge of place value
- adding combinations of whole numbers
- understanding and using division and multiplication as inverse operations
- understanding that multiplying a number by a group of numbers added together is the same as doing each multiplication separately, 7 x 3 is the same as (5 x 3) + (2 x 3). (The Distributive Law)

Using and applying is a key theme and one of the aims of National Curriculum and before children move onto the next stage in written calculation it is important that their skills are broadened through their use and application in a range of contexts, these include:

- using inverse (function machines, etc)
- missing box questions
- using units of measure including money and time (scaling up four times as tall)
- word problems
- open ended investigations

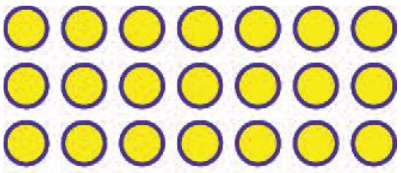
Stage 1: Practical (repeated addition)

Children will work practically with equipment grouping objects to see multiplication as repeated addition. As they become more confident, this practical grouping of objects will be mirrored on a number line using the vocabulary 'lots of', 'groups of', 'how many lots', 'how many times' so that the two are being done together. This will prepare them for the abstract concept of multiplying numbers rather than objects.

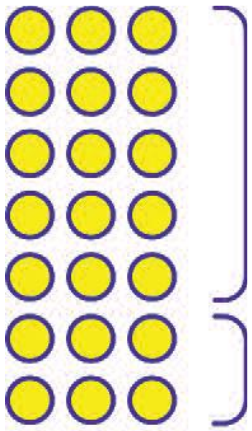


Stage 2: Practical and pictorial arrays (towards grid method)

Children use arrays to demonstrate their understanding of commutativity for multiplication facts and the Distributive law.



3 x 7 = 21



7 x 3 = 21

Children use their knowledge of known multiplication tables

This 7 x 3 array can also be seen as 5 x 3 add 2 x 3

(5x3) + (2x3)

15 + 6 = 21

Also use to demonstrate related division facts

21 ÷ 7 = 3

21 ÷ 3 = 7

Stage 3: Partitioning (grid method)

24 x 3

x	2	0		4		
3	6	0	1	2	7	2

24 x 32

	x		2	0			4			
3	0	6	0	0	1	2	0	7	2	0
	2		4	0			8		4	8
								7	6	8

Expanded method to be modelled by teacher to demonstrate where partitioning (grid method) relates to short (column) method.

	2	4						
x		3						
	1	2	(		4	x	3	)
	6	0	(	2	0	x	3	)
	7	2						

	2	4							
x	3	2							
		8	(			4	x	2	)
	4	0	(		2	0	x	2	)
1	2	0	(		4	x	3	0	)
6	0	0	(	2	0	x	3	0	)
7	6	8							

Stage 4: Short (column method)

24 x 3

	2	4
x		3
	7	2
	1	

1241 x 3

	1	2	4	1
x				3
	3	7	2	3
		1		

Stage 5: Long (column method)

24 x 32

		2	4
x		3	2
		4	8
	7	2	0
	1		
	7	6	8

Put in 0 place holder

1245 x 13

	1	2	4	5
x			1	3
	3	7	3	5
		1	1	
1	2	4	5	0
1	6	1	8	5
		1		

Multiply the top number by the bottom number, starting with top units by bottom units, top tens by units, etc.

Put in 0 place holder

NOTES

Division

Written methods for Division

It is important that children's mental methods of calculation are practised on a regular basis and secured alongside their learning and use of written methods of division.

The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use a written method accurately and with confidence.

Children are taught and acquire secure mental methods of calculation and one written method of calculation for division which they know they can rely on when mental methods are not appropriate.

This policy shows the possible stages of each written method for division, each stage building towards a more refined method.

There are some key basic skills that children need to help with subtraction, which include:

- counting
- estimating
- understanding division as repeated subtraction
- partitioning two-digit and three-digit numbers into multiples of 100, 10 and 1 in different ways

  (432 into 400 + 30 + 2 and also into 300 + 120 + 12)
- recalling multiplication and division facts to 12 × 12
- recognising multiples of one-digit numbers and dividing multiples of 10 or 100 by a single-digit number using their knowledge of division facts and place value
- knowing how to find a remainder working mentally, for example, find the remainder when 48 is divided by 5 ***(please see further note on remainders at end of division section)***
- understanding and using division and multiplication as inverse operations
- read and write the ÷ sign
- recognise and use divisor, dividend and quotient $\overset{\text{quotient}}{\text{divisor}\overline{)\text{dividend}}}$ $3\overline{)81}^{\,27}$
- multiply a two-digit number by a single-digit number mentally;
- be able to subtract numbers using the column method.

Using and applying is a key theme and one of the aims of National Curriculum and before children move onto the next stage in written calculation it is important that their skills are broadened through their use and application in a range of contexts, these include:

- using inverse
- missing box questions
- using units of measure including money and time
- word problems
- open ended investigations

Stage 1: Practical (sharing)

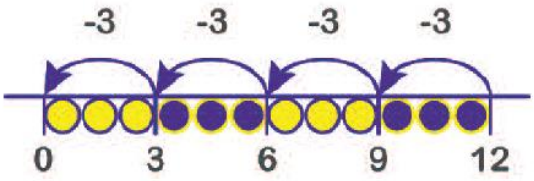
Children will work practically with equipment sharing objects one to one.

12 cakes are shared equally between 3 people.

Stage 2: Number lines (grouping)

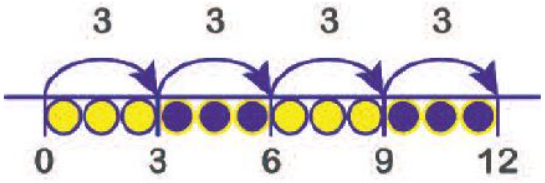
Children will move from sharing objects practically to grouping them, this will be mirrored on a number line, working from right to left so that they see division as repeated subtraction. This will prepare them for the abstract concept of dividing numbers rather than objects.

Each cake box holds 3 cakes, if I have 12 cakes, how many cake boxes will I need?



How many times can I subtract 3 from 12?

Using their knowledge of the inverse relationship between multiplication and division, children can use their multiplication tables when grouping on a number line, working from left to right.



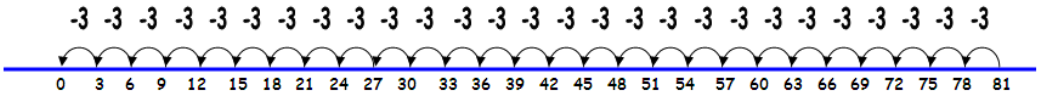
How many groups of 3 are there in 12?

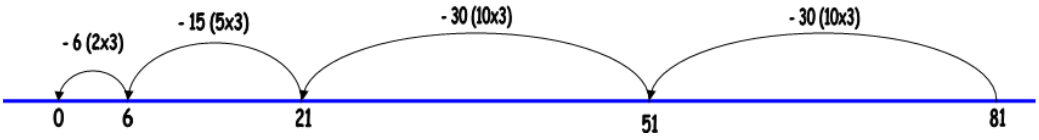
How many chunks of 3 are there in 12?

First without and then with remainders and ensuring that divisors offer an appropriate level of challenge.

Move onto children taking bigger chunks for efficiency and moving towards ‘chunking’ (Stage 3).

81÷3 = 27





Stage 3 Part I: Chunking TU ÷ U, HTU ÷ U

Look back at **Stage 2** and model link between number line and 'chunking' below.

Pupils need plenty of opportunities to practise recording key facts for multiples of single digit numbers.
Also practise recognising multiples from their times tables (factors and multiples). Eg. 21 is **3 x 7** or **7 x 3.**
At first children may take smaller chunks away, but with practice and confidence they will use their Key Facts and take away bigger chunks.

81 ÷ 3

Key facts
10 x 3 = 30
20 x 3 = 60
5 x 3 = 15
2 x 3 = 6

```
   2 7
3) 8 1
 - 3 0   (10 x 3)
   5 1
 - 3 0   (10 x 3)
   2 1
 - 2 1   ( 7 x 3)
     0
```

144 ÷ 4

Key facts
10 x 4 = 40
20 x 4 = 80
5 x 4 = 20
2 x 4 = 8

```
   3 6
4) 1 4 4
 - 8 0   (20 x 4)
   6 4
 - 4 0   (10 x 4)
   2 4
 - 2 4   ( 6 x 4)
     0
```

196 ÷ 6

Key facts
10 x 6= 60
20 x 6= 120
5 x 6= 30
2 x 6= 12

```
   3 2 r4
6)1 9 6
-1 2 0     (20 x 6)
   7 6
 - 6 0     (10 x 6)
   1 6
 - 1 2     ( 2 x 6)
     4
```

Stage 3 Part II: Short Division TU ÷ U, HTU ÷ U

It is useful for children to list multiples of the divisors before they begin the calculation.

Model with place value counters.

81 ÷ 3

$$\begin{array}{r} 2\ 7 \\ 3\overline{)\ 8\ ^{2}1} \end{array}$$

144 ÷ 4

$$\begin{array}{r} 3\ 6 \\ 4\overline{)1\ 4\ ^{2}4} \end{array}$$

196 ÷ 6

$$\begin{array}{r} 3\ 2\ \ r4 \\ 6\overline{)1\ \ 9\ ^{1}6} \end{array}$$

Stage 3 Part III: Chunking HTU ÷ TU

Pupils need plenty of opportunities to practise recording key facts for multiples of single and two digit numbers.

At first children may take smaller chunks away, but with practice and confidence they will use their Key Facts and take away bigger chunks.

364 ÷ 14

Key facts

10 x 14 = 140
20 x 14= 280
5 x 14= 70
2 x 14= 28

$$\begin{array}{rr} & 2\ \ 6 \\ 14\overline{)3\ ^{2}\not{6}\ ^{1}4} & \\ -2\ \ 8\ \ 0 & (20 \times 14) \\ \hline 8\ \ 4 & \\ -\ \ 7\ \ 0 & (5 \times 14) \\ \hline 1\ \ 4 & \\ -\ \ 1\ \ 4 & (1 \times 14) \\ \hline 0 & \end{array}$$

445 ÷ 25

Key facts

10 x 25= 250
20 x 25 = 500
5 x 25 = 125
2 x 25 = 50

$$\begin{array}{rr} & 1\ \ 7\ \ r20 \\ 25\overline{)\not{4}\ ^{3}\not{4}\ ^{1}5} & \\ -2\ \ 5\ \ 0 & (10 \times 25) \\ \hline 1\ \ 9\ \ 5 & \\ -1\ \ 2\ \ 5 & (5 \times 25) \\ \hline 7\ \ 0 & \\ -\ \ 5\ \ 0 & (2 \times 25) \\ \hline 2\ \ 0 & \end{array}$$

Stage 4: Long Division HTU ÷ TU

It is useful for children to list multiples of the divisors before they begin the calculation.

364 ÷ 14

Key facts
10 x 14 = 140
20 x 14= 280
5 x 14= 70
2 x 14= 28

```
         2   6
14  )3  ¹6   4
     2   8   ↓
    ---------
         8   4
  -      8   4
    ---------
             0
```

445 ÷ 25

Key facts
10 x 25= 250
20 x 25 = 500
5 x 25 = 125
2 x 25 = 50

```
         1   7   r  20
25  )4  ¹4   5
  -  2   5   ↓
    ---------
     1   9   5
  -  1   7   5
    ---------
         2   0
```

445 ÷ 25

Remainder as a decimal

```
         1   7  ·8
25  )4  ¹4   5  ·0
  -  2   5   ↓   ↓
    -------------
     1   9   5
  -  1   7   5
    -------------
         2   0  ·0
  -      2   0  ·0
    -------------
                 0
```

Remainder as a fraction

```
         1   7  20/25
25  )4  ¹4   5
  -  2   5   ↓
    ---------
     1   9   5
  -  1   7   5
    ---------
         2   0
```

Remainder a fraction in simplest terms

```
         1   7  4/5
25  )4  ¹4   5
  -  2   5   ↓
    ---------
     1   9   5
  -  1   7   5
    ---------
         2   0
```

Stage 5: Short Division HTU ÷ TU

It is useful for children to list multiples of the divisors before they begin the calculation.

364 ÷ 14

$$\begin{array}{r} 2\ 6 \\ 14\overline{)3\ 6\ {}^{8}4} \end{array}$$

445 ÷ 25

$$\begin{array}{r} 1\ 7\ \text{r}\ 20 \\ 25\overline{)4\ 4\ {}^{19}5} \end{array}$$

445 ÷ 25

Remainder as a decimal

$$\begin{array}{r} 1\ 7\cdot 8 \\ 25\overline{)4\ 4\ {}^{19}5\ {}^{20}0} \end{array}$$

445 ÷ 25

Remainder as a fraction

$$\begin{array}{r} 1\ 7\ \frac{20}{25} \\ 25\overline{)4\ 4\ {}^{19}5} \end{array}$$

445 ÷ 25

Remainder a fraction in simplest terms

$$\begin{array}{r} 1\ 7\ \frac{4}{5} \\ 25\overline{)4\ 4\ {}^{19}5} \end{array}$$

Note on Remainders

Children should be given a variety of questions where they will need to decide what they need to do with the remainder to answer the question correctly (whether they need to record it as it is or round up or down the answer).

29 ÷ 6

1. **I divide 29 pencils equally between 6 people. How many pencils does each person get?**

2. **29 people are going on a journey. Each car holds 6 people. How many cars are needed?**

3. **You collect 29 CD tokens. You can get a CD for every 6 tokens. How many CDs can you get?**

4. **6 people win £29 and divide it equally between them. How much does each person get?**

NOTES