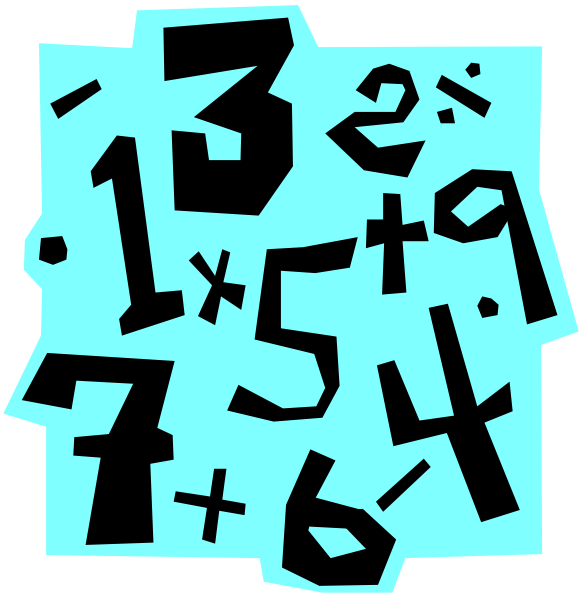
St. Peter's Catholic Primary School

Calculation Guidance

A progression through the four operations



Contents

Rationale

At St Peter's School, children learn a variety of strategies and methods for both mental and written mathematical calculations. This guide considers the developmental progression of understanding children require within the four operations (addition, subtraction, multiplication and division) to become secure and efficient when calculating. It gives practical guidance to the mental and written processes, the language shared, the strategies and resources used.

Number is an abstract concept. Therefore the skill of calculating with numbers is experiential and contextualised using apparatus, problem solving, real life situations, talk and thought. This helps to make calculation relevant and rich.

The Mathematics Curriculum 2014, sets out a progression of the skills, knowledge and processes children are expected to attain during at the end of each year and Key Stage.

When considering a Calculation Policy…

'Pupils are encouraged to move onto a standard efficient method as soon as their understanding is secured.' Number and Calculation

Getting the Best Results (Oxford University Press)

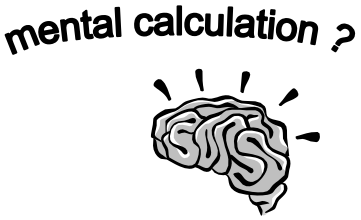
Key to successful calculating…

- numbers are put into **context** – numbers represent real things/situations
- secure **place value** – a 'feel' for the size of numbers and how the base 10 system works
- secure knowledge of **number bonds** and **table facts** – concrete and abstract
- **estimate**/approximate – a sense of reasonableness when solving calculations
- find an **efficient method** for calculation – improve pace
- **check answer** – improve accuracy… independently

“They didn’t do it like that in my day!”

Do your children ask for help with their maths homework and start talking in a foreign language, using words like ‘partitioning’, ‘chunking’, ‘grid multiplication’…..?

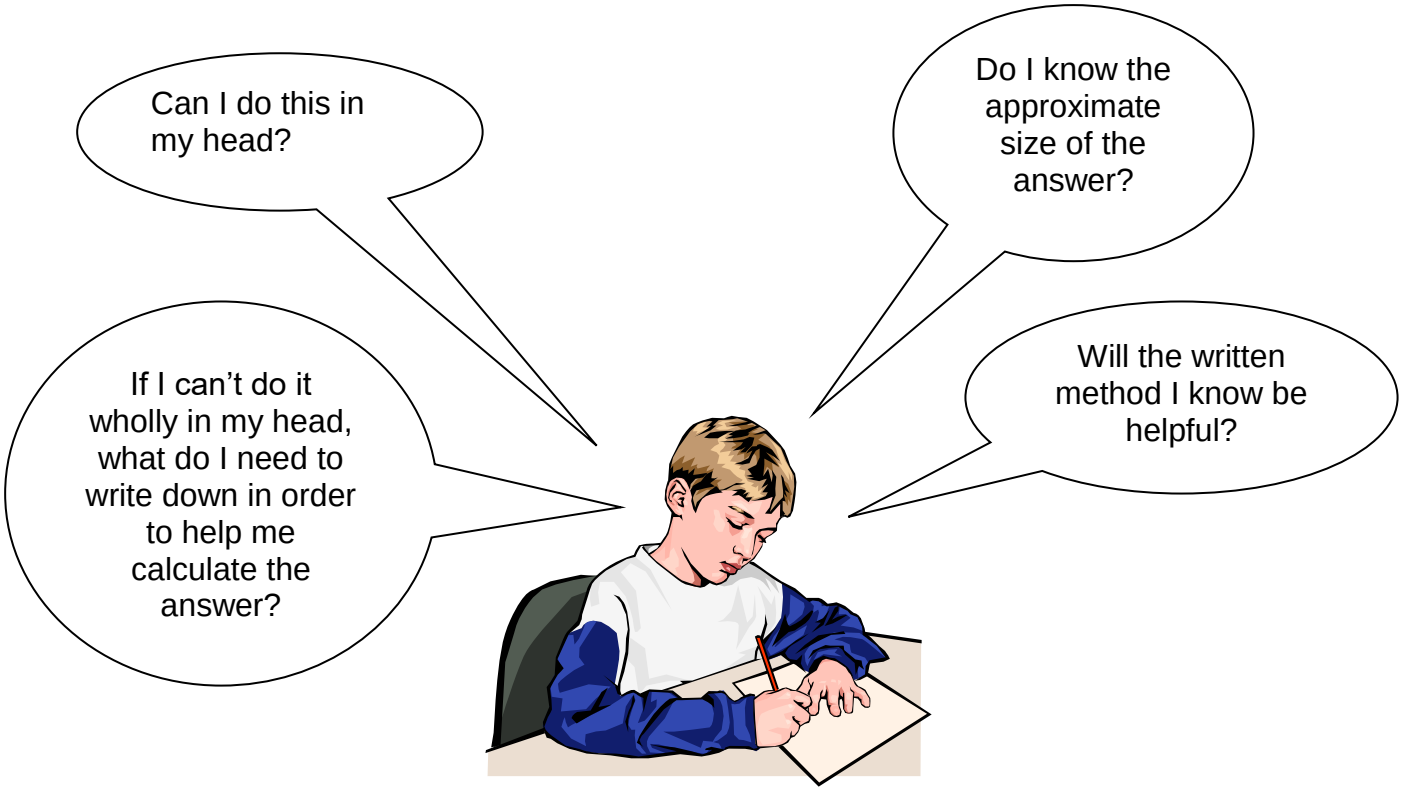
Which is more important:



or

This will depend on the numbers involved and the individual child.

When faced with a calculation, no matter how large or difficult the numbers may appear to be, all children should ask themselves:



When do children need to start recording?

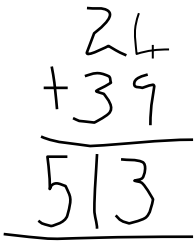
The following table shows how some sort of recording is relevant throughout the primary years with mental strategies playing an important role throughout.

<table>
<tr><th>Yr R</th><th>Yr 1</th><th>Yr 2</th><th>Yr 3</th><th>Yr 4</th><th>Yr 5</th><th>Yr 6</th></tr>
<tr><td colspan="7">Making a record of a calculation</td></tr>
<tr><td></td><td colspan="6">Jotting to support a mental strategy</td></tr>
<tr><td colspan="2"></td><td colspan="5">Explaining a mental strategy</td></tr>
<tr><td colspan="3"></td><td colspan="4">Developing written methods</td></tr>
</table>

It is important to encourage children to look first at the problem and then get them to decide which is the best method to choose – pictures, mental calculation with or without jottings, structured recording or calculator.

(Use of a calculator is not an expectation of the 2014 Primary Maths Curriculum. However, to develop readiness for Secondary education, children might be introduced to it's use for more complex problems.)

Children attempting to use formal written methods without a secure understanding will try to remember rules, which may result in unnecessary and mistaken applications of a standard method.



2014 Primary Maths Curriculum encourages that children can use efficient standard columnar methods of calculation for the four operations by the end of KS2 so that they are 'secondary ready.'

Calculation methods

The following methods illustrated have been adapted from a variety of sources. They show a progression of working so that your child can develop their understanding of the efficient written methods of calculation. Mental strategies and visual resources that teachers will refer to and use when teaching number and calculation are also illustrated. (ref to Key to successful calculating page 3.)

Addition - written progression

Children will hear the language of both '**Units**' and/or '**Ones**' when referring to place value.

ADDITION **Using an informal method by counting on in multiples of 10 with a number line**

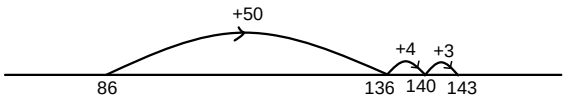
TU + TU
86 + 57

Why use a number line?

It helps me to show on paper what is going on in my head

TU + TU
86 + 57

Start at 86 (the larger number) on the number line. *Partition* the smaller number 57 into tens and units and count on the multiples of 10 first and then the units.



Further partitioning method as highlighted in mental strategies

80 + 50 = 130
6 + 7 = 13
130 + 13 = **143**

This can also be set out with 10s partitions and units partitions according to their place value ready for columnar addition.

86 + 57 = 143

ADDITION **Using a number line to add too much and then subtract *(compensate)***

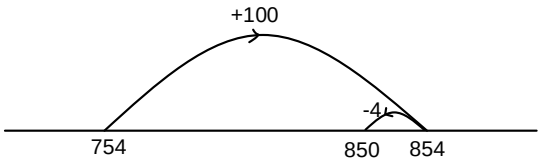
HTU + TU
754 + 96

Why are you subtracting when you should be adding?

I noticed that 96 is close to 100. 100 is easier to add than 96 but that means I've added 4 too many. I need to subtract 4 from the number I reach.

HTU + TU
754 + 96

Start with the larger number 754. Add on 100 and then subtract 4.



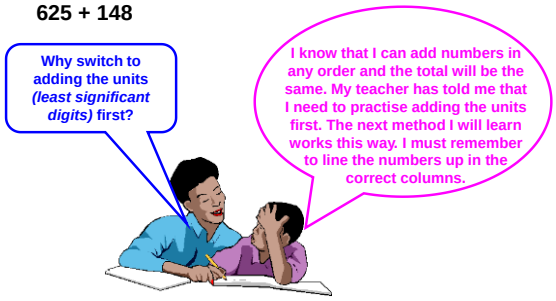
754 + 96 = 850

This will be modelled using **Base 10** apparatus

ADDITION

Expanded method: moving on from adding the *most significant digits* first to adding *least significant digits* first

HTU + TU
625 + 148



HTU + HTU
625 + 148

Add *most significant digits* first:
(in this example, **hundreds**)

625	
+ 148	
700	600 + 100
60	20 + 40
13	5 + 8
773	

Add *least significant digits* first:
(in this example, **units**)

625	
+ 148	
13	5 + 8
60	20 + 40
700	600 + 100
773	

Mentally add
700 + 60 + 13 = 773

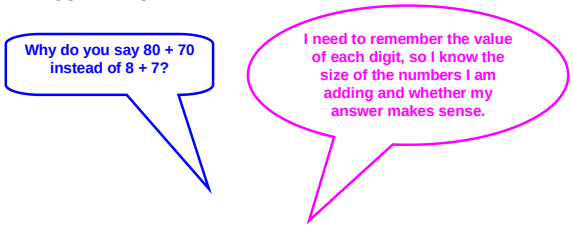
625 + 148 = 773

Stages will be modelled using **Base 10** apparatus

ADDITION

Using a standard method

HTU + HTU
587 + 475



HTU + HTU
587 + 475

587	
+ 475	
1062	
1 1	

7 + 5 = 12
Place the 2 in the units column and carry the 10 forward to the tens column.

80 + 70 = 150 then + 10 (carried forward) which totals 160.
Place 60 in the tens column and carry the 100 forward to the hundreds column.

500 + 400 = 900 then + 100 which totals 1000. Place this in the thousands column (remembering to hold the place value in the hundreds column with a zero).

587 + 475 = 1062

Addition – mental methods, strategies and resources

Year 1

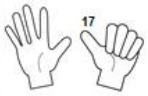
Using Place Value

Count on in ones/tens, e.g. knowing 45 + 1 or 45 +10 without counting on in ones.

45 + 10 = 55

Counting On

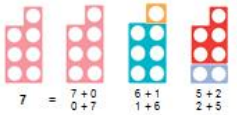
Count on in ones, e.g 11 + 6 =



Count on in tens, e.g. 45 + 20 as 45, 55, **65**

Using Number Facts

Number bonds to and of 10.



Patterns using known facts, e.g. 4 + 3 = **7** so we know 24 + 3, 54 + 3 etc.

Year 2

Using Place Value

Know 1 more or 10 more than any number.

Partition, e.g. **57 + 36**

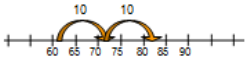
50 + 30 = 80

7 + 6 = 13

80 + 13 = **93**

Counting On

Add 10 and multiples of 10, e.g. **63 + 20** as 63, 73, 83 or as one jump 63, 83



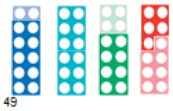
Add two 2-digit numbers by counting on in tens then in ones, e.g. **57 + 36** as 57 add 30 (87) add 6 (**93**).

Add 'nearly' numbers, (near multiples) and adjust by counting on or back e.g. 46 + **21**, 58 + **19**

Using Number Facts

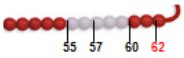
Number bonds to and of 20.

12 =



Patterns of known facts, e.g. 3 + 6 = **9**, so 53 + 6 = 59, 46 + 3 = 49

Bridging 10 e.g.57 + 5 as 57 add 3 then add 2 more.



Adding 3 or more single digit numbers, spotting bonds to 10 and doubles, e.g. 6 + 7 + 4 + 2 as 10 + 7 + 2

Year 3

Using Place Value

Count in hundreds, e.g. 475 + 200 as 475, 575, **675**

Add multiples of 10, 100 and £1.

236 + 300

236 + 40

= **276**

£6.34 + £5 as £6 + £5 + 34p

Partition **68 + 75**

60 8

70 5

130 + 12 = **142**

Counting On

Add two 2-digit numbers by adding the multiple of ten then the ones, e.g. 67+55 as 67 add 50 (117) add 5 (**122**)

Add 'nearly' numbers, (near multiples of 10 and 100) and adjust by counting on or back, e.g. 67 + **39** or 362 + **199**

Count on from 3-digit numbers, e.g. 247 + 34 as 247 + 30 (277) then 277 + 4 = **281**

Knowing addition is commutative, count on from the larger number, e.g. 43 + 132 as 132 + 43.

Using Number Facts

Number bonds to 100. 30 + 70

65 + 35

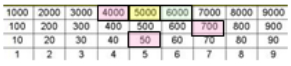
85 + 15 etc

Add to next ten and next 100, e.g. 176 + 4 = 180, 485 + 15 = 500

Year 4

Using Place Value

Count in thousands, e.g 4750 + 2000 as 4750, 5750, **6750**

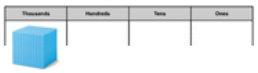


Partition **756 + 138**

700 50 6

100 30 8

800 + 80 + 14 = **894**



Counting On

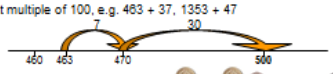
Add two 2-digit numbers by adding the multiple of ten then the ones, e.g. 67+55 as 67 add 50 (117) add 5 (**122**)

Add 'nearly' numbers, (near multiples of 10, 100 and 1000) and adjust by counting on or back e.g. 3462 + **2999**, 3462 + **4001**, £4.67 + **£1.99**

Count on to add 3-digit numbers and money, e.g. 463 + 124 as 463 + 100 (563) + 20 (583) + 4 = **587**
£4.67 + £5.30 as £9.67 + 30p

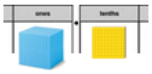
Using Number Facts

Number bonds to 100 and next multiple of 100, e.g. 463 + 37, 1353 + 47



Number bonds to £1 and next whole pound, e.g. £3.45 + 55p

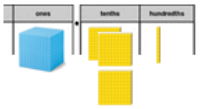
Add to the next whole number, e.g. 4.6 + 0.4, 7.2 + 0.8



Year 5

Using Place Value

Count in 0.1s, 0.01s, e.g. knowing what 0.1 more than 1.21 is



1.21 + 0.1 = **1.31**

Partition **2.4 + 5.8**

2 4

5 8

7 + 1.2 = **8.2**

Counting On

Add two decimal numbers by adding ones then tenths/hundredths, e.g. 5.72 + 3.05 as 5.72 add 3 (8.72) then add 0.05 (8.77)

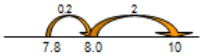
Add 'nearly' numbers, (near multiples of 1) and adjust by counting on or back, e.g. 6.34 + **0.99**, 5.63 + **0.9**, 4.82 + **1.1**

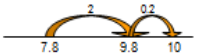
Count on from large numbers, e.g. 6834 + 3005 as 9834 + 5

Using Number Facts

Number bonds to 1 and to the next whole number, e.g. 0.4 + 0.6, 5.7 + 0.3

Add to next ten from a decimal number, e.g. 7.8 + 2.2 = **10**





Year 6

Using Place Value

Count in 0.1s, 0.01s, 0.001s, e.g. knowing what 0.01 more than 1.221 is

1.221 + 0.01 = **1.231**

Partition **9.54 + 3.25**

9 5 04

3 2 05

12 + 0.7 + 0.09 = **12.79**

Counting On

Add two decimal numbers by adding ones then tenths/hundredths or thousandths, e.g. 6.314 + 3.006 as 6.314 add 3 (9.314) then add 0.006 (**9.32**)

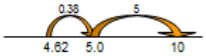
Add 'nearly' numbers, (near multiples of 1) and adjust by counting on or back, e.g. 6.345 + **0.999**, 5.673 + **0.9**, 4.892 + **1.1**

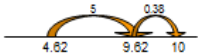
Count on from large numbers, e.g. 16375 + 12005 as 28375 + 5

Using Number Facts

Number bonds to 1 and next multiple of 1, e.g. 0.63 + 0.37, 2.355 + 0.645

Add to next ten, e.g. 4.62 + 5.38 = **10**





Subtraction - written progression

SUBTRACTION (A) Counting on or (B) counting back?

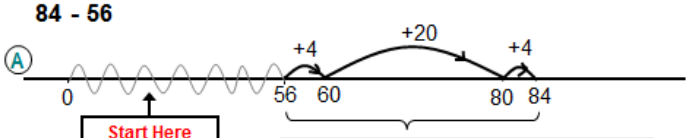
TU - TU
84 - 56

How do you decide whether to count on or count back?

If the numbers are close together like 203 – 198 it's quicker to count on. If they're a long way apart like 203 – 5 it's quicker to take away. Sometimes I count on because that's easier than taking away.

TU - TU
84 - 56

(A)

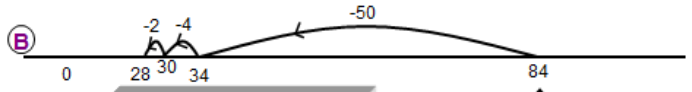


Start Here

Start by 'taking away' (crossing out) the 56.

Find the *difference* between the two numbers.
Count on from 56 to 84.
20 + 4 + 4 = 28

(B)



Partition 56 and count back (subtract) 50 and then 6.

Start HERE

84 – 56 = 28

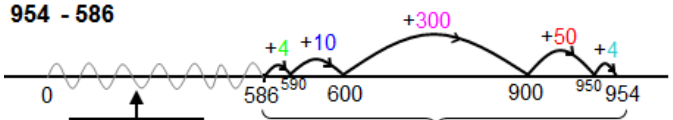
SUBTRACTION Complementary addition

HTU - HTU
954 - 586

The number line seems a very clear method.

As I get better with my number bonds, I can do the calculation in fewer steps. I can see the number line in my head and do it mentally.

HTU - HTU
954 - 586



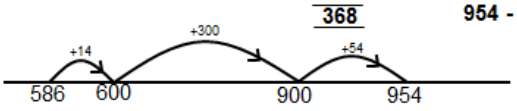
START HERE

'Take away' the 586.

Find the *difference* between the two numbers.
Count on from 586 to 954.
300 + 50 + 10 + 4 + 4 = 368

Count on to the next multiple of 10.	4	To make 590
Count on to the next multiple of 100.	10	To make 600
Count on in 100s.	300	To make 900
Count on to the larger number in the calculation which is 954.	50	To make 950
	+ 4	To make 954
	368	

954 - 586 = 368



This will be modelled using **Base 10** apparatus

SUBTRACTION

Working towards a standard method *(decomposition)*

HTU - TU
154 - 37

Why do you need to rearrange the numbers 50 + 4 and rewrite them as 40 + 14?

The whole number is 154. It is possible to subtract 7 but for this method I need to do one subtraction in each column. So I exchange one ten from the tens column for ten ones in the units column.

HTU - TU
154 - 37

Both these numbers are partitioned into their HTU parts, so we can do 3 easier calculations.

54 is the same value as 40 10 4
Now 7 can be subtracted from 14.

Subtract the units, tens, then hundreds.

100 + 50 + 4
\- 30 + 7

40 10
100 + 50 + 4
\- 30 + 7

100 + 40 + 14
\- 30 + 7

100 + 10 + 7 = 117

100 – 0 = 100 | 40 – 30 = 10 | 14 – 7 = 7

Here the answers from each calculation are added to give the answer.

154 - 37 = 117

SUBTRACTION

Standard method *(decomposition)*

HTU - HTU
754 - 286

Why didn't you use the standard method straight away?

Because all the stages I have learnt before have really helped me understand exactly what I'm doing.

HTU - HTU
754 - 286

54 is the same value as 40 10 4.
Now 6 can be subtracted from 14.

740 is the same value as 600 + 100 + 40.
Now 80 can be subtracted from 140.

Or, more efficiently the *standard method*.

700 + 50 + 4
\- 200 + 80 + 6

600 + 140 + 14
\- 200 + 80 + 6

600 + 140 + 14
\- 200 + 80 + 6
400 + 60 + 8 = 468

754
\- 286
468

754 – 286 = 468

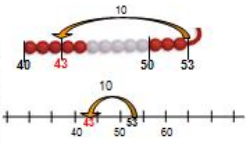
Stages will be modelled using **Base 10** apparatus

Subtraction – mental methods, strategies and resources

Year 1

Using Place Value

Count back in ones/tens, e.g. knowing 53 -1 or 53 -10 without counting back in ones.



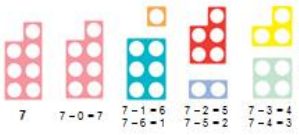
Taking Away

Count back in ones, e.g 13 - 6 =

Count back in tens, e.g. 53 - 20 as 53, 43, 33

Using Number Facts

Number bonds to and of 10



Patterns using known facts, e.g. 7 – 3 = 4 so we know 27 - 3, 57 – 3, 67 - 4 etc.

Year 2

Using Place Value

Know 1 less or 10 less than any number

Partition, e.g. **57 - 36**

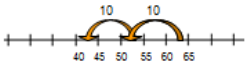
50 - 30 = 20

7 - 6 = 1

20 + 1 = **21**

Taking Away

Subtract 10 and multiples of 10, e.g. **63 - 20** as 63, 53, 43 or as one jump 63 – 20 = 43

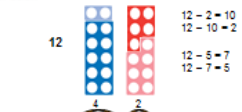


Subtract two 2-digit numbers by counting back in tens then in ones, e.g. **57 - 36** as 57 subtract 30 (27) subtract 6 (**21**)

Add 'nearly' numbers, (near multiples) and adjust by counting on or back e.g. 46 - **21**, 58 - **19**

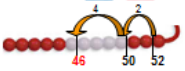
Using Number Facts

Number bonds to and of 20



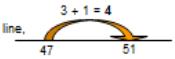
Patterns of known facts, e.g. 9 - 6 = 3, so 59 - 6 = 53, 49 - 6 = 43

Bridging 10 e.g.52 - 6 as 52 subtract 2 then subtract 4 more



Counting Up

Find a **difference** between two numbers on a line, e.g. 51 - 47



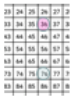
Year 3

Taking Away

Use place value to subtract , e.g. 246 – 200, 246 – 40, 246 - 6

Take away multiples of 10, 100 and £1, e.g. 476 – 40 = 436, 476 – 300 = 176, £4.76 - £2 = £2.76

Visualise the 100 square, e.g. 476 – 40 = 436



Partition **68 - 42**

60 8

40 2

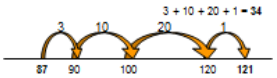
20 + 6 = **26**

Count back in hundreds, tens then ones, e.g. 763 – 121 as 763 – 100 (663) then subtract 20 (643) then subtract 1 (642)

Subtract 'nearly' numbers, (near multiples of 10 and 100) and adjust by counting on or back, e.g. 648 - **199** or 86 - **39**

Counting Up

Find a **difference** between two numbers by counting up from the smaller to larger number, e.g. 121 – 87 = **34**



Using Number Facts

Number bonds to 100, e.g. 100 – 35 = **65**

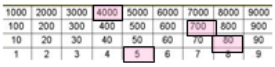
100 – 15 = **85**

100 – 42 = **58**

Year 4

Taking Away

Use place value to subtract e.g. **4785** – 4000, 4785 – 80 etc.



Take away multiples of 10, 100, 1000, £1, 10p or 0.1, e.g. 8392 – 50, 6372 – 3000, £3.74 -30p, 5.6 – 0.2 etc

Partition **5456 - 3020**

5000 - 3000 = 2000 406 = 2436

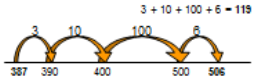
50 - 20 = 30

Count back, e.g. 6482 – 1301 as 6482 -1000 – 300 – 1 (**5181**)

Subtract 'nearly' numbers and adjust by counting on or back, e.g. 6483 - **2999** or £34.86 - **£19.99**

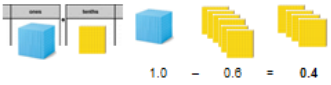
Counting Up

Find a **difference** between two numbers by counting up from the smaller to larger number, e.g. 506 – 387 = **119**



Using Number Facts

Number bonds to 10, 100 and derived facts, e.g. 100 – 76 = 24, 1.0 – 0.6 = 0.4



Number bonds to £1 and £10, e.g. £1.00 – 86p = 14p, £10.00 - £3.40 = £6.60

Year 5

Taking Away

Use place value to subtract decimals, e.g. 4.58 – 0.08

Take away multiples of powers of 10, e.g. 15,672 – 300, 2.71 – 0.5 etc

Partition or count back, e.g. 5.42 - 3.01

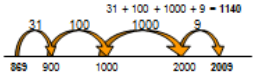
5 - 3 = 2 4

2 - 1 = 0.01 = 2.41

Subtract 'nearly' numbers and adjust by counting on or back, e.g. 86,456 - **9999** or 3.58 - **1.99**

Counting Up

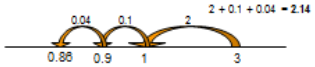
Find a **difference** between two numbers by counting up from the smaller to larger number, e.g. 2009 – 869 = **1140**



Find change using shopkeepers' addition, e.g. buy toy for £6.89 with £10 note

Using Number Facts

Derived facts from number bonds to 10 and 100, e.g. 2 – 0.45 using 45 + 55 = 100, 3.00 – 0.86 using 86 + 14 = 100



Number bonds to £1, £10 and £100, e.g. £4.00 - £3.86 = 14p, £100 - £66 using 66p + 34p = £1

Year 6

Taking Away

Use place value to subtract decimals, e.g. 7.782 - 0.08

Take away multiples of powers of 10, e.g. 132,956 – 400, 7.823 – 0.5 etc

Partition or count back, e.g. 5.425 - 4.003

5 - 4 = 1 42

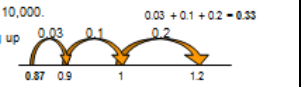
005 - 003 = 0.002 = 1.422

Subtract 'nearly' numbers and adjust by counting on or back, e.g. 360,078 – **99,998** or 12.831 - **0.99**

Counting Up

Count up to subtract numbers from multiples of 10, 100, 1000, 10,000.

Find a **difference** between two decimals numbers by counting up from the smaller to larger number, e.g. 1.2 – 0.87



Using Number Facts

Derived facts from number bonds to 10 and 100, e.g. 0.1 – 0.075 using 75 + 25 = 100, 5 – 0.65 using 65 + 35 = 100

Number bonds to £1, £10 and £100, e.g. £7.00 - £4.37 = £2.63, £100 - £66.20 using 20p + 80p = £1 and £67 + £33 = £100

Multiplication - written progression

MULTIPLICATION

Introducing multiplication on a number line

TU X U
14 x 5

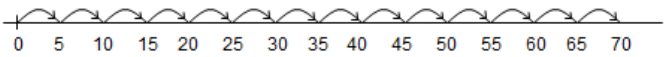
How is multiplication the same as repeated addition?

The number line helps me see each group of 5 clearly. If I add 5 fourteen times, that is the same as 5 multiplied by 14 (5 x 14). I can make 14 individual jumps of 5 along the number line, or 1 jump of 5 x 10 and 1 jump of 5 x 4. Table facts will help me do this more quickly.

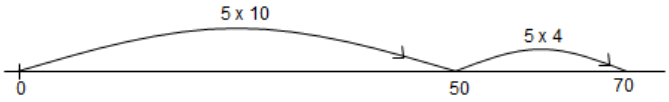
TU x U
14 x 5

The number line shows 5 multiplied by 14. This is equal to 14 multiplied by 5 (14 jumps of 5 on the number line). Working with *arrays* will model this.

5 x 14



Multiplication is like *repeated addition.*



Using table facts to make bigger jumps is more efficient.

5 x 14 = 14 x 5 = 70

GRID MULTIPLICATION

TU X U
14 x 5

Why do you *partition* the numbers into tens and units?

It doesn't take long! I can see what I have to multiply very easily.

TU X U
14 x 5

Partition TU number into tens and units parts.
14 becomes 10 and 4

14 x 5

X	10	4	70
5	50	20	

50 comes from multiplying 10 by 5. It is called a *part-product.*

20 comes from multiplying 4 by 5. Another *part-product.*

The *part – products* are totalled to give the *final product* or answer of 70.

14 x 5 = 70

GRID MULTIPLICATION

TU X TU
46 x 32

Isn't it difficult to multiply 40 by 30?

I know that 30 is 3 x 10 and multiplying by 10 is easy so I do 40 x 3 x 10 = 120 x 10 = 1200.

You've got to do a lot of calculations – don't you get confused?

The layout of the grid helps me organise what I have to do. I like this method.

TU X TU
46 x 32

Both numbers are *partitioned* into their tens and units parts,
46 becomes 40 and 6 and 32 becomes 30 and 2.

46 x 32

X	40	6	
30	1200	180	1380
2	80	12	92
			1472

The *part products* are added in stages to give the final *product* or answer of 1472.

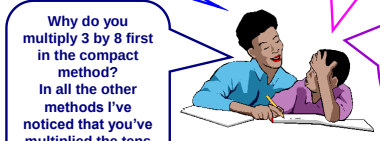
46 x 32 = 1472

MULTIPLICATION

Grid method, Expanded method and Compact method

TU X U

23 x 8



What are the brackets for in the expanded method?

They remind me which numbers I am multiplying. I also have to remember to line the numbers up as hundreds, tens and units.

Why do you multiply 3 by 8 first in the compact method? In all the other methods I've noticed that you've multiplied the tens number first!

I multiply the units first so I can carry forward any tens I need to! This method is very quick but I have to remember to add on any numbers I carry forward.

TU X U

23 x 8

GRID METHOD

X	20	3	
8	160	24	184

EXPANDED METHOD

20 multiplied by 8 equals 160. 3 multiplied by 8 equals 24.

Final product from totalling the *part-products*.

HTU

23

x 8

160 (20 x 8)

24 (3 x 8)

184

COMPACT METHOD

(short multiplication)

HTU

23

x 8

184

2

3 multiplied by 8 equals 24 (the first *part product*).

2 is the 2 tens that need to be carried forward and added to the next *part product*.

20 multiplied by 8 equals 160 (2nd *part product*), **plus** the 2 tens equals 180.

The digits are put in the correct columns, to give the answer 184.

23 x 8 = 184

MULTIPLICATION

TU X TU

46 x 32

I recognise the long multiplication method. How do you multiply 46 by 30?

Well!... I know that 46 x 30 is the same as 46 x 3 x 10. I know my answer will end in zero when I multiply this whole number by 10. So... I put the zero in first. Then I multiply 46 x 3 using the short multiplication method.

TU X TU

46 x 32

GRID METHOD

X	40	6	
30	1200	180	1380
2	80	12	92
			1472

EXPANDED METHOD

The 4 *part products* are set out vertically underneath the calculation.

Part products totalled to give final product.

46

x 32

1200 (40 x 30)

180 (6 x 30)

80 (40 x 2)

12 (6 x 2)

1472

COMPACT METHOD

(long multiplication)

46

x 32

1380 (46 x 30)

92 (46 x 2)

1472

46 x 30 is the same as 46 x 3 x 10.

46 x 2 mentally or by short multiplication.

46 x 32 = 1472

46

x 32

92

1380

1472

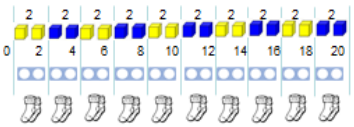
The algorithm should only be considered when place value and partitioning are totally secure

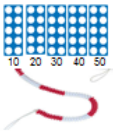
Multiplication – mental methods, strategies and resources

Year 1

Counting in Steps

Count in 2s and 10s



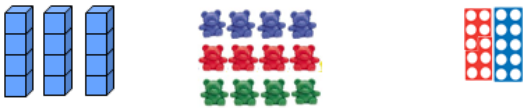


Doubling and Halving

Find doubles to double 6 using fingers

Grouping

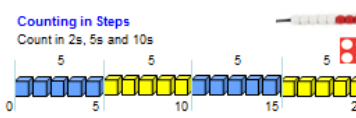
Begin to use visual and concrete arrays and 'sets of' objects to find the answers to '3 lots of 4' or '2 lots of 5', etc



Year 2

Counting in Steps

Count in 2s, 5s and 10s



Begin to count in 3s

Doubling and Halving

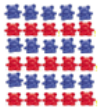
Begin to know doubles of multiples of 5 to 100, e.g. double 35 is 70

Grouping

Grouping along beaded strings and marked/blank number lines.

4 x 3 =

Use arrays to find answers to multiplication and relate to counting in steps, e.g. 4 x 3 as three lots of four things, 5 x 6 as six steps in the 5s and count as well as six lots of five



Using Number Facts

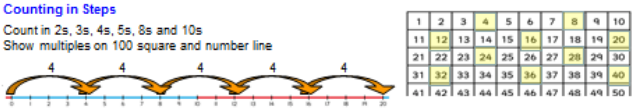
Know doubles to double 20, e.g. double 7 = 14

Start learning 2x, 5x, 10x tables, relating these to counting in steps in 2s, 5s and 10s, e.g. 5 x 10 = 50, and 10, 20, 30, 40, 50, is five steps in tens count

Year 3

Counting in Steps

Count in 2s, 3s, 4s, 5s, 8s and 10s
Show multiples on 100 square and number line

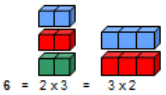


Doubling and Halving

Find doubles to double 50 using partitioning
Use doubling as a strategy in multiplying by 2, e.g. 18 x 2 is double 18 (36)

Grouping

Recognise that multiplication is commutative, e.g. 2 x 3 = 3 x 2
Multiply multiples of 10 by single digit numbers, e.g. 30 x 8 = 240



6 = 2 x 3 = 3 x 2

Using Number Facts

Know doubles to double 20 and doubles of multiples of 5 to 100, e.g. double 45 is 90

Know 2x, 3x, 4x 5x, 8x, 10x tables facts.

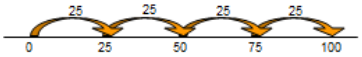
Know 4x as 2x and 2x again.

Make generalisations about multiples, e.g. 2x, 4x, 6x, 8x 10x are all even, 5x end with 0 or 5

Year 4

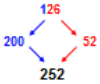
Counting in Steps – Sequences

Count in 2s, 3s, 4s, 5s, 6s, 7s, 8s, 9s, 10s, 11s, 12s, 25s, 50s, 100s, and 1000s



Doubling and Halving

Find doubles to double 100 and beyond using partitioning
Begin to double amounts of money, e.g. £3.50 doubled is £7
Use doubling as a strategy in multiplying by 2, 4 and 8
e.g. 34 x 4 is double 34 (68) doubled again (136)



Grouping

Use partitioning to multiply 2-digit numbers by single digit numbers
Multiply multiples of 100 by single digit numbers using tables facts,
e.g. 400 x 8 = 3200
Multiply using near multiples by rounding, e.g. 24 x 19 as (24 x 20) - 24

Using Number Facts

Know times tables up to 12 x 12

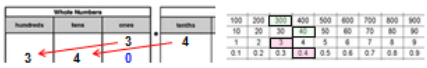
Year 5

Doubling and Halving

Double amounts of money using partitioning,
e.g. £6.73 doubled is double £6 (£12) plus double 73p (£1.46)
Use doubling as a strategy in multiplying by 2, 4, 8, 5 and 20
e.g. 58 x 5 = half of 58 x 10 (580) is **290**

Grouping

Multiply decimals by 10, 100, 1000,
e.g. 3.4 x 100 = **340**

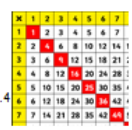


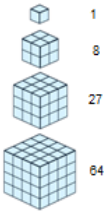
Use partitioning to multiply 2-digit and 3-digit numbers by single digit numbers
e.g. 402 x 6 as 400 x 6 (2400) and 2 x 6 (12)

Use partitioning to multiply decimal numbers by single digit numbers,
e.g. 4.5 x 3 as (4 x 3) + (0.5 x 3)
Multiply using near multiples by rounding,
e.g. 32 x 29 as (32 x 30) - 32

Using Number Facts

Know times tables up to 12 x 12 to multiply multiples of the multiplier - **scaling**,
e.g. 4 x 6 = 24 so 40 x 6 = 240, 400 x 6 = 2400, 0.4 x 6 = 2.4
Know square numbers and cube numbers

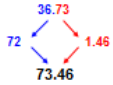




Year 6

Doubling and Halving

Double decimal numbers with up to 2 places using partitioning,
e.g. 36.73 doubled is double 36 (72) plus double 0.73 (1.46)



Use doubling and halving as strategies in mental multiplication

Grouping

Use partitioning as a strategy in mental multiplication, as appropriate,
e.g. 3060 x 4 as (3000 x 4) + (60 x 4), 8.4 x 8 as 8 x 8 (64) and 0.4 x 8 (3.2)
Use factors in mental multiplication, e.g. 421 x 6 as 421 x 3 (1263) doubled (2526),
3.42 x 5 as half of (3.42 x 10)
Multiply decimal numbers using near multiples by rounding,
e.g. 4.3 x 19 as 4.3 x 20 (86 – 4.3)

Using Number Facts

Use times tables facts up to 12 x 12 in multiplication of large numbers or numbers with up to 2 decimal places,
e.g. 6 x 4 = 24 and 0.06 x 4 = 0.24

Division - written progression

DIVISION

TU ÷ U

29 ÷ 3

Introducing division on a number line

Why are you adding on one line and subtracting on the other? And what has subtraction got to do with division?

I need to see how many groups of 3 there are in 29, so I either add on or take away groups of 3 until I can't add or take any more. Using the subtraction method will help me later on.

TU ÷ U

29 ÷ 3

START HERE

Counting on in groups of 3 on a number line.

9 groups of 3 on a number line.

2 left over

0 3 6 9 12 15 18 21 24 27 29

2 left over

Counting back in groups of 3 on a number line.

9 groups of 3 on a number line.

START HERE

0 2 5 8 11 14 17 20 23 26 29

There are 9 groups of 3 in 29, with 2 left over (remainder 2).

29 ÷ 3 = 9 r2

DIVISION

TU ÷ U

72 ÷ 5

Chunking on a number line

I've never heard of chunking before! How does this help with division?

If I can, I try to take out 10 groups of the number I'm dividing by. This is a big chunk and makes the calculation easier. But I can take out chunks that are any number of groups.

TU ÷ U

72 ÷ 5

Numberlines can be vertical or horizontal.

10 x 5

4 x 5

r2

0 2 22 72

START HERE

Subtract 4 groups of 5 (20) from 22 to land on 2.

Subtract 10 groups of 5 (50) from 72 to land on 22.

START HERE

14 groups of 5 subtracted altogether.

2 left! This is the *remainder.*

START HERE

72

10 x 5

22

4 x 5

r2

2

0

72 ÷ 5 = 14 r2

DIVISION BY CHUNKING

HTU ÷ U

256 ÷ 7

How do you decide what size chunk to subtract?

I look for chunks of 10 first. If I take bigger chunks it makes the calculation quicker and easier. Method C is shorter and more efficient than B.

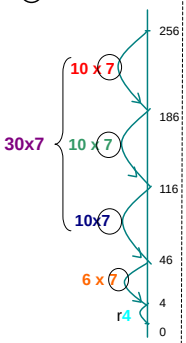
HTU ÷ U

256 ÷ 7

How many groups of 7 in 256?

Children will also link remainders with fractions or decimals in context.

A



B

256
-70 (7 x 10)
186
-70 (7 x 10)
116
-70 (7 x 10)
46
-42 (7 x 6)
4

Subtract chunks of 70 (7 x 10).

How many groups of 7 in 46?

Total the numbers of groups of 7.

10 + 10 + 10 + 6 = 36

C

256
-210 (7 x 30)
46
-42 (7 x 6)
4

Subtract one large chunk of 210 (7 x 30).

36 groups of 7 have been subtracted and there is 4 left over.

256 ÷ 7 = 36 r4

SHORT COMPACT DIVISION

Isn't it easier to say 'how many 3s in 4?'

I need to remember the value of each digit so I know whether my answer makes sense. I will only use this method when I am confident with mental and chunking methods of division.

HTU ÷ U

471 ÷ 3

```
  1
3 4 7 1
```

Q: What is the largest number of hundreds that will divide exactly by 3?
A: 300 divided by 3 = 100. This leaves 100 which is exchanged for ten tens in the tens column.

```
  1 5
3 4 7 1
```

Q: What is the largest number of tens that will divide exactly by 3?
A: 150 divided by 3 = 50. This leaves 20 which is exchanged for 20 units in the units column.

```
  1 5 7
3 4 7 1
```

Q: What is the largest number of units that will divide exactly by 3?
A: 21 divided by 3 = 7

471 ÷ 3 = 157

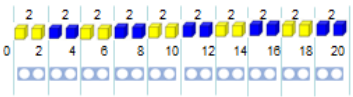
Once secure, the language is then adapted to the standard algorithm.

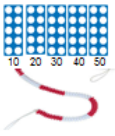
Division – mental methods, strategies and resources

Year 1

Counting in Steps

Count in 2s and 10s





Doubling and Halving

Find half of even numbers up to 12 realising that it is harder to halve odd numbers


Half of 4 is 2


Half of 6 is 3

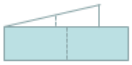

Half of 7 is ...

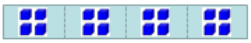
Grouping

Begin to use visual and concrete **arrays** and 'sets of' objects to find the answers to 'how many towers of **4** can I make with **12** cubes?'

Sharing

Begin to find half of a quantity using sharing, e.g. **quarter** of **16** cubes by giving one each repeatedly to **four** children

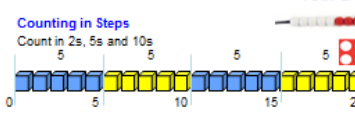




Year 2

Counting in Steps

Count in 2s, 5s and 10s



Doubling and Halving

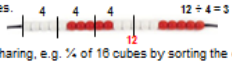
Find half of numbers up to 40, including realising that half of an odd number gives a remainder of 1 or an answer containing ½.
Begin to know half of multiples of 10 to 100, e.g. half of 70 is 35

Grouping

Relate division to multiplication by using arrays or towers of cubes to find answers to division, e.g. how many towers of 5 cubes can I make from 20 cubes as ☐ x 5 =20 and also 20 ÷ 5 = ☐

Relate division to counting in steps and hence to multiplication, e.g. how many 5s do I count to get to 20?

Show groupings on beaded strings and number lines.



Sharing

Begin to find half or a quarter of a quantity using sharing, e.g. ¼ of 16 cubes by sorting the cubes into four piles
Find ¼, ½, ¾, of small quantities

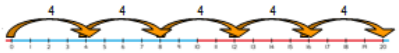
Using Number Facts

Know halves of even numbers to 24
Know 2x, 5x, 10x division facts
Begin to know 3x division facts

Year 3

Counting in Steps

Count in 2s, 3s, 4s, 5s, 8s and 10s by colouring numbers on the 100 square or using a landmarked line



Doubling and Halving

Find half of even numbers to 100 using partitioning
Use halving as a strategy in dividing by 2,
e.g. 36 ÷ 2 is half of 36 (18)

Grouping

Recognise that division is **not** commutative, e.g. 16 ÷ 8 ≠ 8 ÷ 16
Relate division to multiplications, e.g. ☐ X 5 = 30 is the same calculation as 30 ÷ 5 = ☐
thus we can count in 5s to find the answer
Divide multiples of 10 by single digit numbers, e.g.240 ÷ 8 = 30

Using Number Facts

Know halves of even numbers to 40

Know halves of multiples of 10 to 200 e.g. half of 170 is 85

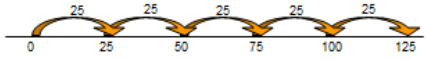
Know 2x, 3x, 4x 5x, 8x, 10x division facts

Use division facts to find unit and simple non-unit fractions of amounts within the times tables, e.g. ¼ of 48 is 3 x (48 ÷ 4)

Year 4

Counting in Steps – Sequences

Count in 2s, 3s, 4s, 5s, 6s, 7s, 8s, 9s, 10s, 11s, 12s, 25s, 50s, 100s, and 1000s



Doubling and Halving

Find halves of even numbers to 200 and beyond using partitioning
Begin to half amounts of money, e.g. £9 doubled is £4.50
Use halving as a strategy in dividing by 2, 4 and 8
e.g. 164 ÷ 4 is half of 164 (82) halved again **(41)**

Grouping

Use multiples of 10 x the divisor to divide by number ≤ 9 above the tables facts,
e.g. 45 ÷ 3
Divide multiples of 100 by single digit numbers using division facts,
e.g. 3200 ÷ 8 = 400

45 ÷ 3 = ☐
☐ x 3 = 45
10 x 3 = 30
15
5 x 3 = 15

Using Number Facts

Know times tables up to 12 x 12 and all related division facts
Use division facts to find unit and non-unit fractions of amounts within the times tables,
e.g. 7/8 of 56 is 7 x (56 ÷ 8)

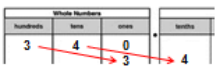
Year 5

Doubling and Halving

Halve amounts of money using partitioning,
e.g. Half of £14.84 as half of £14 and half of 84p
Use doubling as a strategy in dividing by 2, 4, 8, 5 and 20,
e.g. 115 ÷ 5 as double 115 (230) ÷ 10

Grouping

Divide numbers by 10, 100, 1000 to obtain answers with up to 3 decimal places, e.g. 340 ÷ 100 = 3.4



Use the 10th, 20th, 30th ...multiple of the divisor to divide 2 digit numbers by single digit numbers,
e.g. 186 ÷ 6 as 30 x 6 (180) and 1 x 6 (6)
Find unit and non-unit fractions of large amounts, e.g. 3/5 of 265 is 3 x (265 ÷ 5)

Using Number Facts

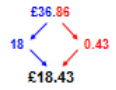
Use division facts from the times tables up to 12 x 12 to divide multiples of powers of ten of the divisor,
e.g. 3600 ÷ 9 using 36 ÷ 9 – **scaling**
Know square numbers and cube numbers

Year 6

Doubling and Halving

Halve decimal numbers with up to 2 places using partitioning,
e.g. half of £36.86 is half of 36 (18) plus half of 0.86 (0.43)

Use doubling and halving as strategies in mental division,
e.g. 216 ÷ 4 is half of 216 (108) and half of 108 (54)



Grouping

Use 10th, 20th, 30th, ...or 100th, 200th, 300th, ... multiples of the divisor to divide large numbers,
e.g. 378 ÷ 9 as 40 x 9 =360 and 2 x 9 =18 so the answer is 42
Use tests for divisibility, e.g. 135 divides by 3 as the sum of it's digits = 9, and 9 is a multiple of 3

Using Number Facts

Use division facts from the times tables facts up to 12 x 12 to divide decimal numbers by single digit numbers,
e.g. 1.17 ÷ 3 is 1/100 of 117 ÷ 3 (0.39) - **scaling**

Divisibility Rules

A number is divisible by. . .		Divisible	Not Divisible
2	if the last digit is even (0, 2, 4, 6, or 8).	3,978	4,975
3	if the sum of the digits is divisible by 3.	315	139
4	if the last two digits form a number divisible by 4.	8,512	7,518
5	if the last digit is 0 or 5.	14,975	10,978
6	if the number is divisible by both 2 and 3	48	20
9	if the sum of the digits is divisible by 9.	711	93
10	if the last digit is 0.	15,990	10,536

Calculations in Context

All the methods in this booklet support children in using their mental and written skills to solve calculations. Children need to be encouraged to use the method that they understand and can use confidently.

It is important that children are able to choose the most appropriate method for the calculation. For example:

4003 - 3998

These numbers are very close together and so counting up on a number line (actual or imagined) would be the most efficient method.

200 ÷ 4

Dividing by 4 is the same as halving and halving again. As it is easy to halve 200 and easy to halve 100, this would be the most efficient method.

Using and applying appropriate skills is very important, when calculations are needed to solve a problem.

4 C.DS at £2.99 – how much altogether?

£2.99 is almost £3.00 and so round up, multiply, then adjust:
4 x £3.00 = £12.00
£12.00 – 4p = £11.96

Supporting your child with their mathematics

- You are more likely to have a self-motivated child if you let them explain the method to you and work with them.
- Start from where your child is and not where you want them to be.
- Focus on the positive and do not take ‘ownership’ of their efforts and achievements.
- Let them make mistakes and know that this is acceptable.
- Be positive and enthusiastic and enjoy your maths together!
- If your child is really stuck and you cannot help them any further, take the homework back to school and ask for help.