Mossford Green's
Maths Calculation Booklet
Years 1-2

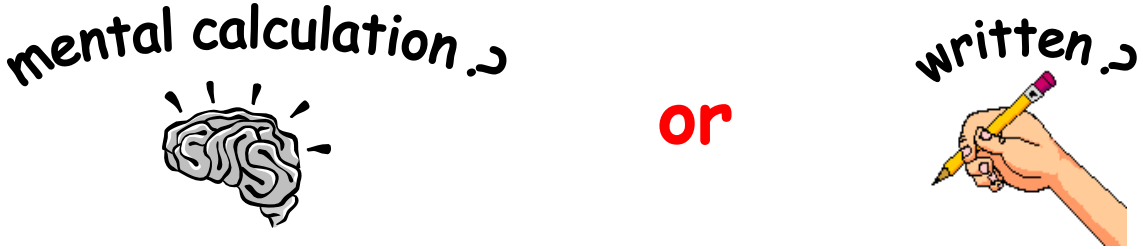
This is the way we do it!

“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’…..?

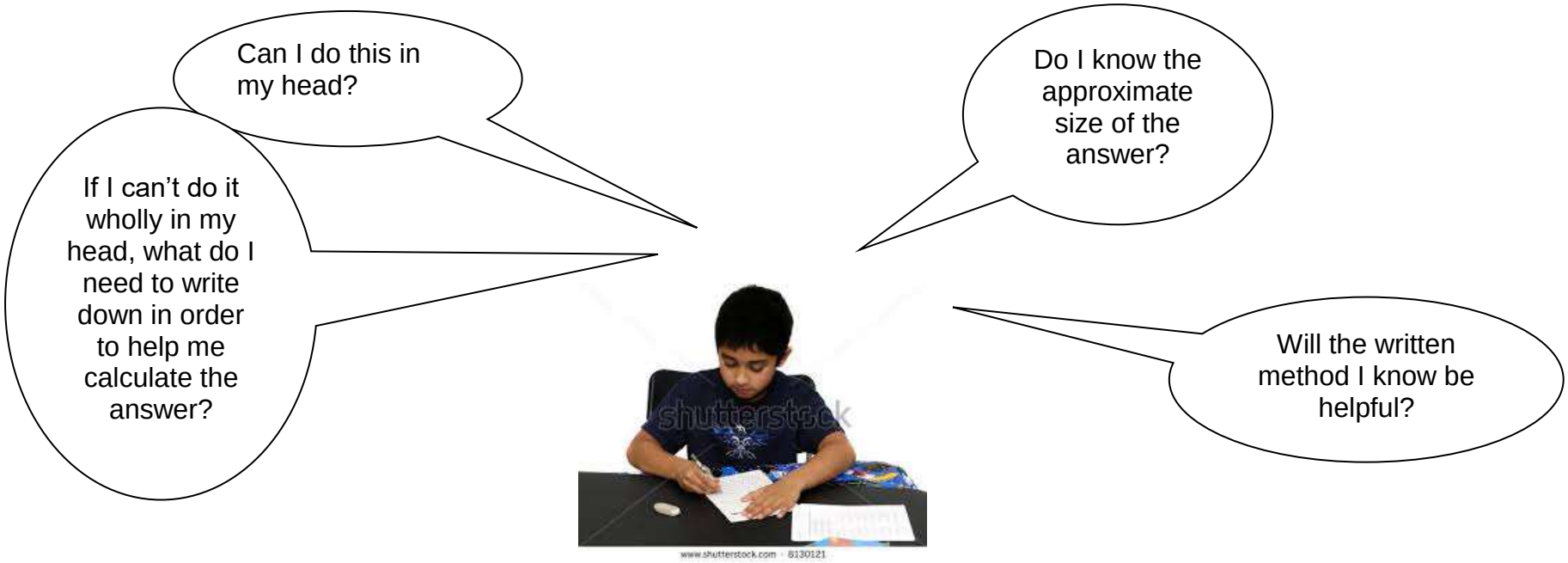
If so, you may feel the need for some translation. This booklet is designed to explain some of the methods used to teach calculation in schools.

Which is more important:



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:



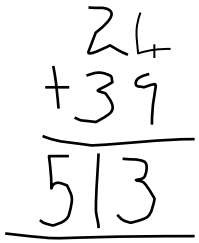
When do children need to start recording?

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

Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year6
← Making a record of a calculation →						
		← Jotting to support a mental strategy →				
			← Explaining a mental strategy →			
				← Developing written methods →		

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.

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.



Some of the methods explained in this booklet involve 'partitioning' and a set of place value cards are attached which can be pasted onto card and cut out (your child will show you how to use them).

ADDITION

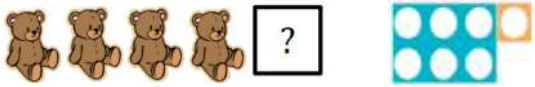
Prerequisite skills

Counting numbers to 20

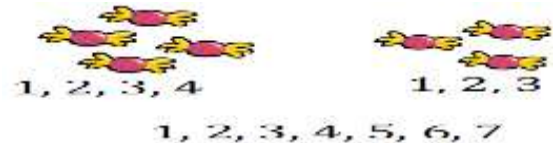
Place numbers to 20 in order

Bonds up to 10 and to make 10

1 more than a number



Addition as combining groups



Relate number bonds to 10 to add multiples of 10 up to a total of 100 e.g. if

3 + 4 is 7 then 30 + 40 is 70

Use familiar objects to recognise the place value of 2 digit numbers.

Recognise and explain 24 is '2 tens and 4 ones'

Addition as counting on

Doubling numbers within 20

Progressing to: PARTITIONING AND RECOMBINING
Partition into tens and ones and recombine Pre J10 **(before jumping in 10s**

12 + 23 = 10 + 2 + 20 + 3
= 30 + 5
= 35

As part of the early calculations policy, there are 3 ways for children to add numbers on a number line.

Jumping 10 – jumping in 10s and 1s
Targeting 10 – targeting a multiple of 10
O 10 – over jumping and adjusting

Jumping 10 – jumping in 10s and 1s

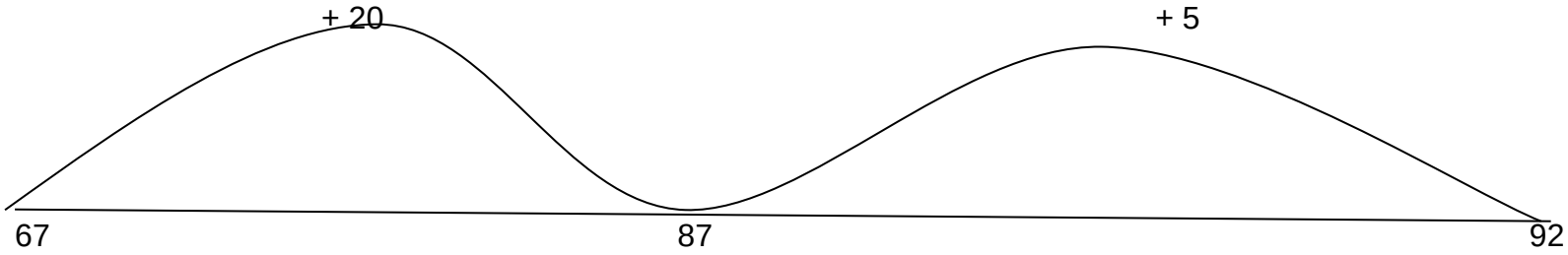
J10 – Jumping in 10s and 1s

This method involves starting with the largest number on the left of the number line. The small number is then partitioned and children jump, first adding the tens and then the units.

Children should write above the jump how much they are adding (e.g. +10, +1).

Once confident, children can progress to adding all the tens followed by all the units in one jump

67 + 25



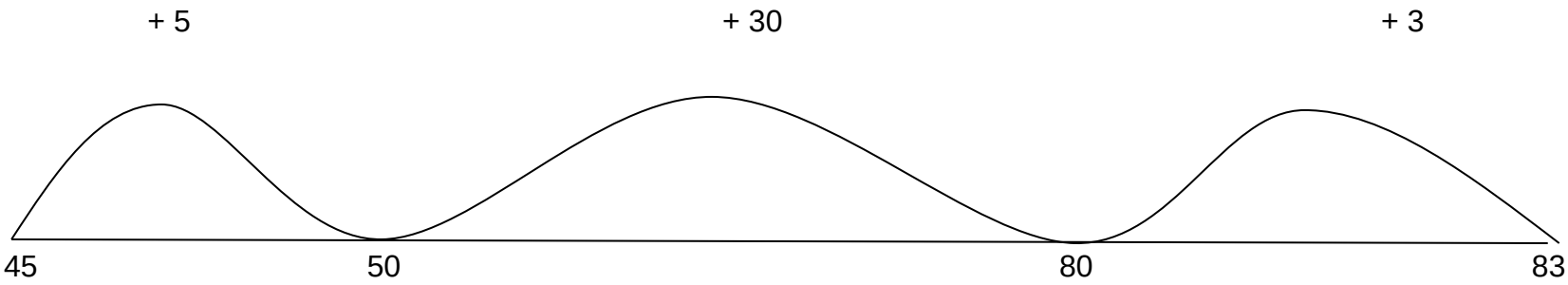
Once confident, children can progress to adding all the tens followed by all the units in one jump (eg + 50 + 2)

Target 10 – targeting a multiple of 10

T10 – Targeting a multiple of 10

Children use their knowledge of known facts to target the tens, starting with the largest number. They add whatever number is needed to reach the next multiple of ten and then add on whatever is remaining.

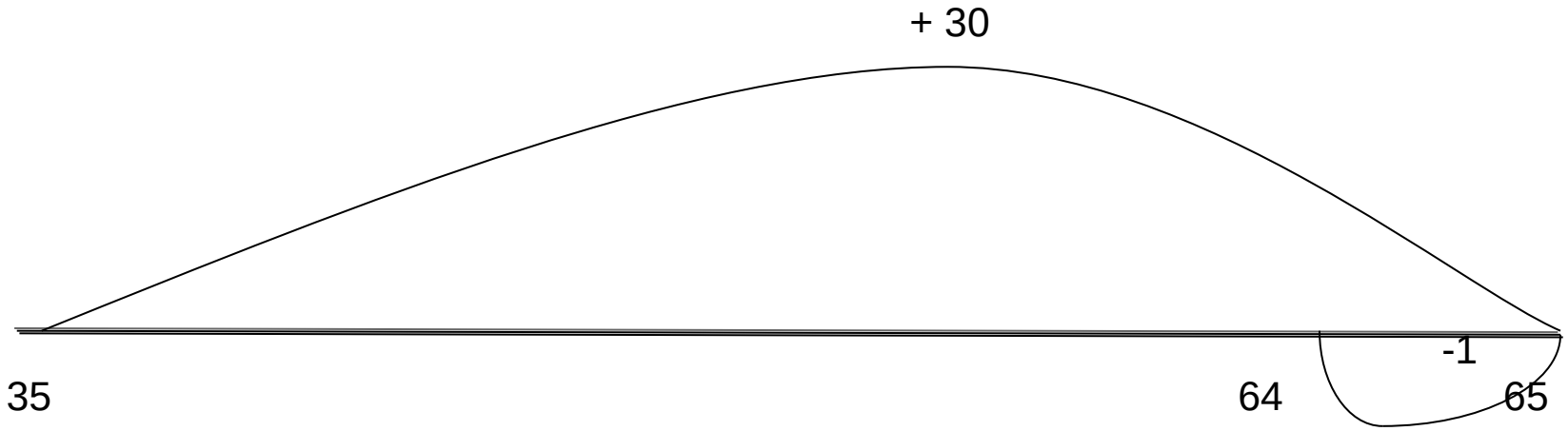
45 + 38



O10 – Over jumping and adjusting

This method would only really be used if one of the numbers ends in a 9 or a 1 (possibly a 8 or a 2). The round the number being added to the nearest multiple of ten and then jump by this amount along the number line. Adjustments would then be made by adding or subtracting (whichever is appropriate).

35 + 29



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

Why use a number line?

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

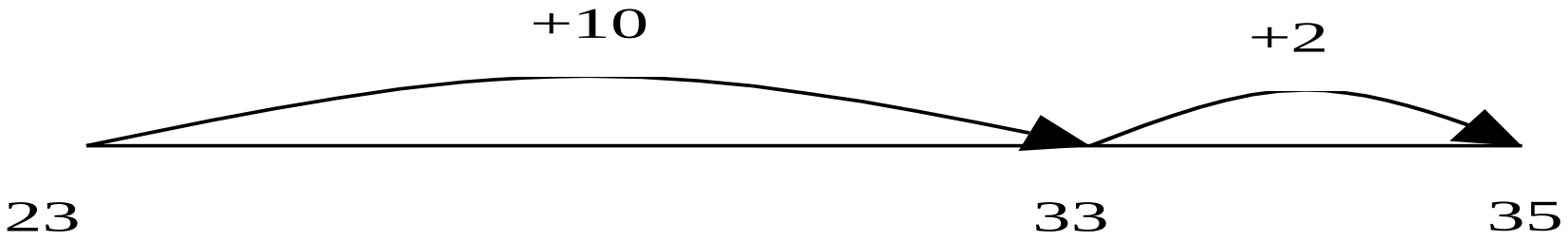
Jumping 10 – example

TU + TU

23 + 12

10 **2**

Start at 23 (the larger number) on the number line. *Partition* the smaller number 12 into tens and units and count on the multiples of 10 in jumps of tens and then the units. The number reached at the end of the number line is the answer.



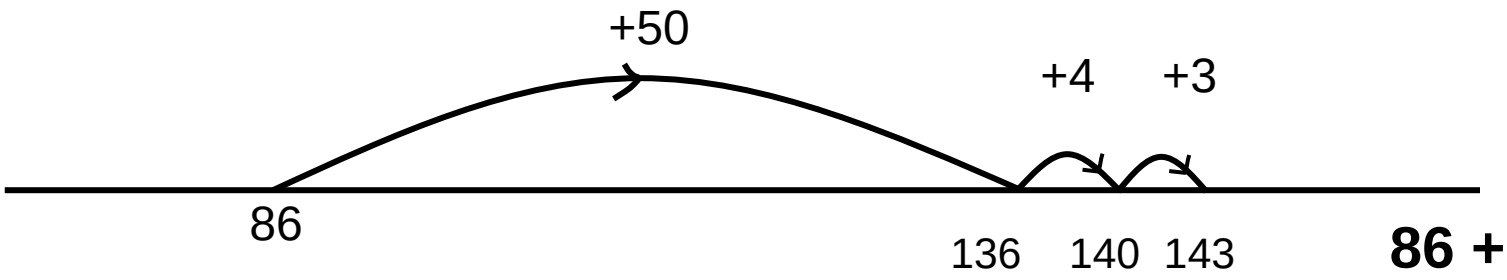
Jumping 10 – example

Once a child has become confident, they will be able to make larger jumps in one go.

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.

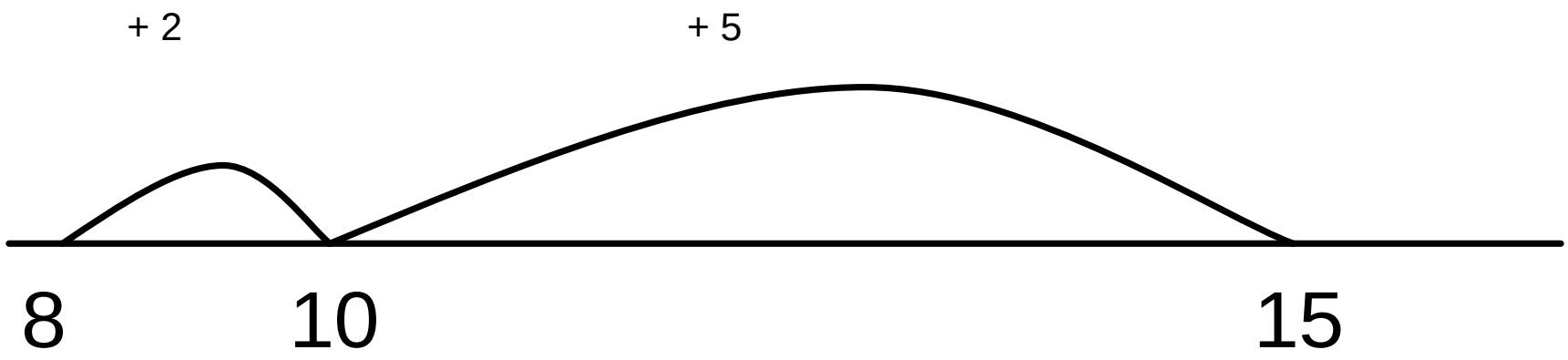


86 + 57 = 143

Targeting 10

(Targeting the 10, partitioning and bridging through 10)

8 + 7 =



Children should be able to partition the 7 to relate adding the 2 first to target the 10 and then the 5.

ADDITION

Number line to add too much and then subtract (Over 10)

HTU + TU

754 + 96

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.

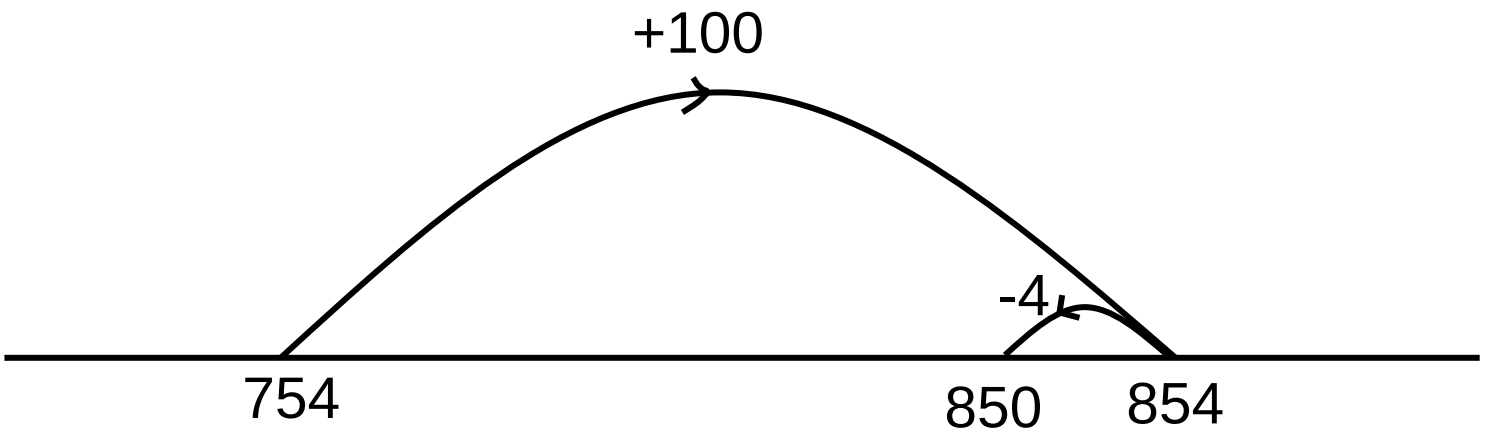
Why are you subtracting when you should be adding?

010 – Example

HTU + TU

754 + 96

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



754 + 96 = 850

Progression from Mental Maths

- Mental method, using partitioning

Mental methods involve partitioning the numbers, then adding the tens and the units separately.

Partition into hundreds, tens and ones and recombine

Either partition both numbers and recombine or partition the second number only e.g.

358 + 73 = 358 + 70 + 3

= 428 + 3

HTU + TU

358 + 73 = 358 + 70 + 3

= 428 + 3

= 431

End of Year Objectives for Addition

Yr1 – Represent and use number bonds and related subtraction facts with 20
Add and subtract one and two digit numbers to 20
Solve one step problems that involve addition, using concrete objects and images to support
Recall and use jottings for U + U, T +U, T+ T, TU+T
Yr2 – Recall and use addition and subtraction facts to 20
Use and recall related number facts up to 100
Add TU+U, T+TU, TU+TU, U+U+U

Differentiation Steps for each Stage:

- Not crossing tens
- Crossing Tens
- Crossing Hundreds Only
- Crossing Tens and Hundreds

In addition:

- The number line must be modeled as an image to support calculation from Reception to Year 6
- Jottings must be modelled as a clear image/strategy for mental calculation
- If the calculation can be carried out mentally then do not give it to practice vertical calculation e.g. TU + TU should not be calculated vertically

Always present calculations horizontally in order to consider mental calculations first.

SUBTRACTION

PREREQUISITE SKILLS:

Prerequisite skills (based on the practical)
Number bonds to 10

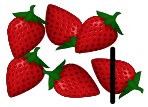
Counting back from 20

Find one less than a given number

Subtract using quantities and objects 2 single digit numbers

Count back to subtract single digit numbers

Understand subtraction as 'take away'



There are two concepts linked to subtraction:

Subtract - where it is natural to count back to 'take away'
Find the difference – where the understanding of the vocabulary leads to using addition to count on

SUBTRACTION

Use a number line to count on from the smallest number to the largest number

TU - TU

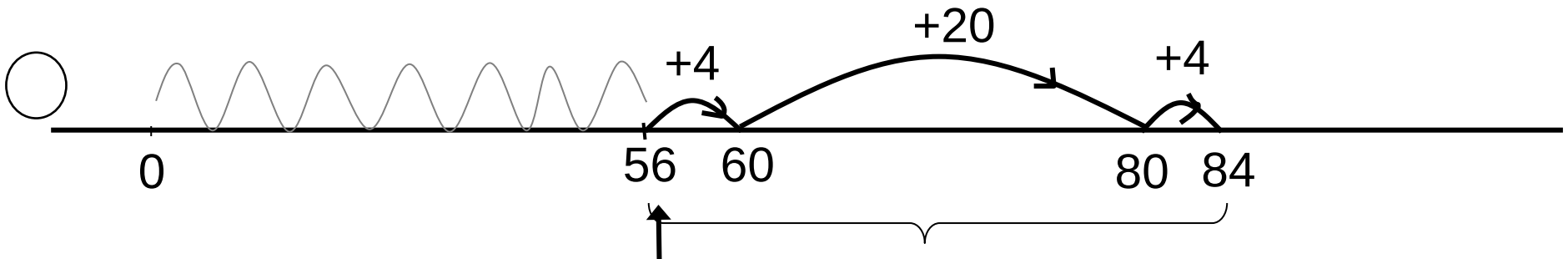
84 - 56

Why do you count on for a subtraction question?

Counting on a number line is easier than taking away, especially if the numbers are close together like 203 – 198.

TU - TU

84 - 56



START HERE

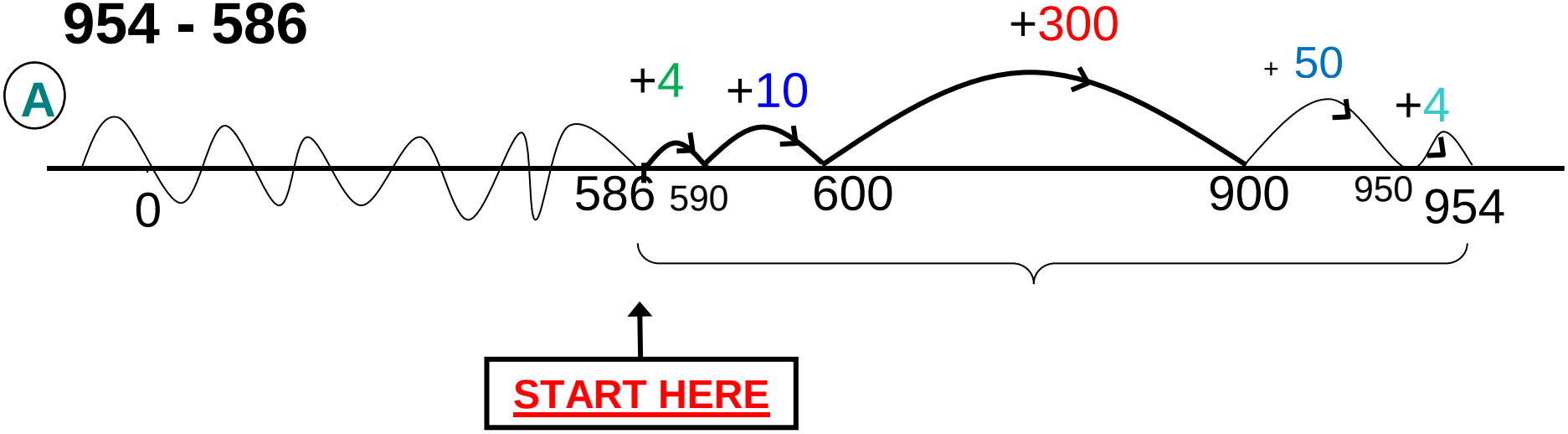
Start by ‘taking away’ (crossing out) the 56.

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

84 – 56 = 28

HTU - HTU

954 - 586



‘Take away’ the 586

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

End of Year Objectives for Subtraction

Year 1 – mentally subtract U-U, TU-U, TU- TU (up to 20 e.g. 15 – 12)
subtract one digit and two digit numbers to 20
solve one step problems that involve subtraction, using concrete objects and images
Year 2 - mentally TU-U, TU-multiple of 10, mentally with informal jottings TU-TU
subtract numbers using concrete objects and images
show that addition of 2 numbers can be done in any order and subtraction of one number from another cannot
solve problems with subtraction using concrete objects and images
Year 3 – subtract mentally, HTU – U, HTU – T, HTU – H, TU-U, TU-TU. Formal written methods for TU-TU, HTU-TU, HTU-HTU
Year 4 – as above and efficient written methods for ThHTU-ThHTU, ThHTU-HTU, U.t – U.t, £U.th-£U.th
Year 5 – Efficient written methods for subtraction of 2 integers with more than 4 digits e.g. 45230 - 12432 and decimals with up to 2dp e.g. 54.34-29.78
Year 6 – as above

Please note:

There are two concepts linked to subtraction:
Subtract - where it is natural to count back to 'take away'
Find the difference – where the understanding of the vocabulary leads to using addition to count on [complementary addition].

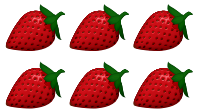
- Children should not move on to a written method if they are not completely confident with using a number line.
- Children will need to have had experience of different types of jumping on a number line e.g. T10 (target the ten), J10 (jump in 10s) and know how to partition numbers in different ways.
- These methods can also be easily applied, at different levels, to finding differences in values of money, measures and time**.**

Always present calculations horizontally in order to consider mental calculations first

MULTIPLICATION

Prerequisite skills

Multiplication is related to known facts including doubling and counting groups of the same size.



3 + 3

E.g. use of dominoes and dice.

Counting using a variety of practical resources

Numicon and bead strings

Counting in 2s e.g. counting socks, shoes, animal's legs…

Counting in 5s e.g. counting fingers, fingers in gloves, toes…

Counting in 10s e.g. fingers, toes…

MULTIPLICATION

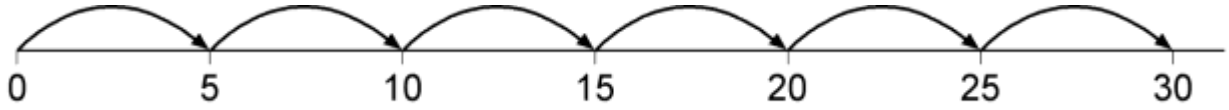
Introduction to Multiplication

Multiplication is repeated addition

For example:

5 × 6 = 30 Which is the same as *5 + 5 + 5 + 5 + 5 + 5 = 30*

We can use a number line to show the repeated addition and work out the answer.

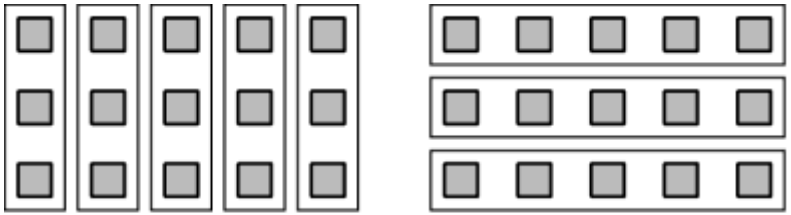


MULTPICATION

Using arrays to support multiplication

An array is objects or shapes that are arranged in a rectangle. Arrays are very important in helping children understand how multiplication works.

They learn that in the array the answer is always the same (eg 3 × 5 is the same as 5 × 3), even when you rotate.



MULTIPLICATION

Introducing multiplication on a number line

TU X U

14 x 5

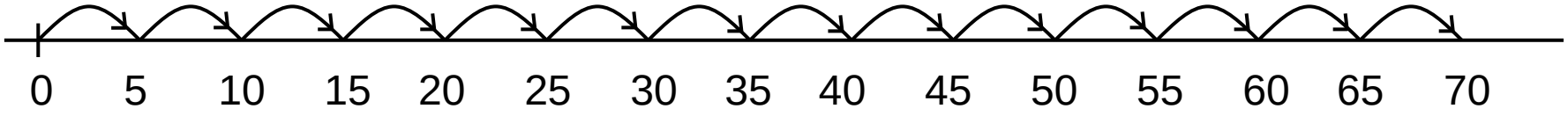
How is multiplication the same as repeated addition?

**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.**

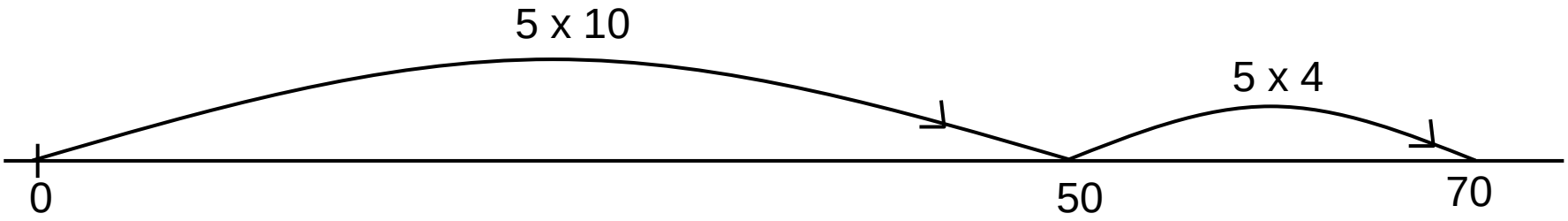
TU x U

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).



Multiplication is *repeated addition*.



Using table facts to make bigger jumps is more efficient.

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	
5	50	20	**70**

50 + 20 = 70

50 comes from multiplying 10 by 5.

20 comes from multiplying 4 by 5.

14 x 5 = 70

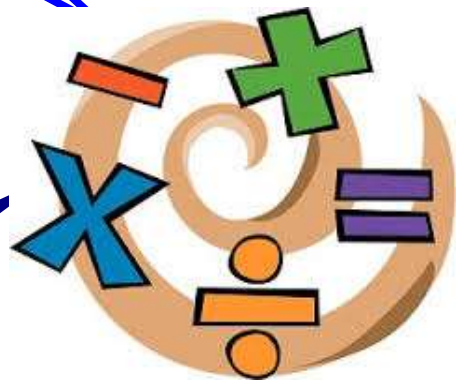
GRID MULTIPLICATION

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

End of Year Objectives for Multiplication

Year 1–practical problems that combine groups of 2, 5 or 10
Year 2 -represent multiplication as repeated + and arrays. Practical and informal written methods and vocabulary used to support multiplication alongside known facts and mental strategies. Understand and use '3 for free' for x and □of the 2, 3,4,5,6, 8 and 10 times-tables.
Year 3 –Describe the effect of Ux10, TUx10, Ux100, TU x 100. Practical and informal written methods for TU x U.
Year 4 –Derive and recall x and ÷ facts up to 12 x 12 and '3 for free' facts. Multiply numbers to 1000 by 10 and 100. Formal written layout and explain TU/HTU x U.
Year 5 –mentally multiply TU x U. Multiply whole numbers and decimals by 10, 100 and 1000. Formal written methods to multiply ThHTU x U, ThHTU x TU, U.t x U
Year 6 –mentally calculate TU x U, U.t X U. Formal written methods to multiply up to 4 digit by 2 digit and one digit with up to 2 decimal places.

<u>As with addition and subtraction, before progressing through the stages of calculation:</u>

Learning

- It is crucial to know or be able to derive key number facts:
  - ⇨ Understand and use doubling and halving
  - ⇨ ×/÷ 10 (as moving a place to the left/right NOT "add a zero" etc.!!)
- Place value and partitioning MUST be clearly understood and explained using the appropriate mathematical vocabulary.

Teaching

- The number line and the use of arrays must be modelled as images to support calculation from Reception to Year 6.
- Jottings must be modelled as a clear image/strategy for mental calculation.
- If the calculation should be possible mentally then do not give it to practise vertical calculation, e.g. 23 x 15 should not be calculated vertically. Consider use of numbers carefully.

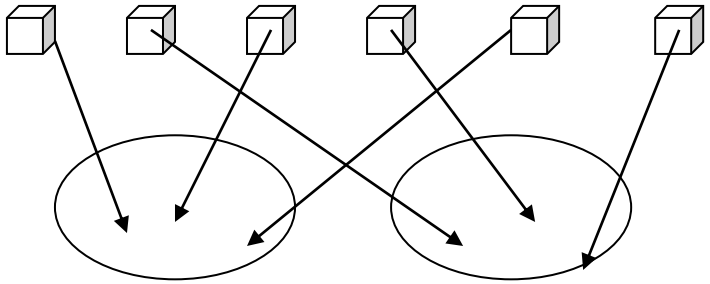
Always present calculations horizontally in order to consider mental calculations first

DIVISION

Sharing objects equally

<u>SHARING</u> equally *occurs when a quantity is shared out equally into a given number of portions, and we can work out how many are in each portion.*

E.g. 6 ÷ 2 (share 6 sweets between 2 children)



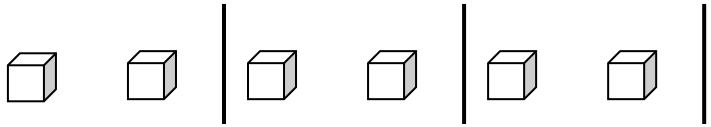
Sharing can be carried out using practical apparatus, such as cubes.

If children <u>only</u> understand the sharing model of subtraction they will need very good knowledge of tables in order to carry out division

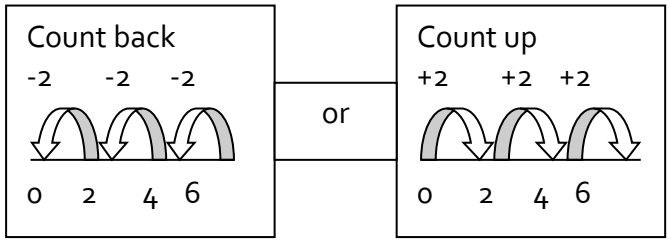
<u>GROUPING</u> (or repeated subtraction) *occurs when we are asked to find how many groups of a given size are equivalent to the original quantity. For example how many groups of 2 marbles are in a set of 6 marbles, the calculation*

6 ÷ 2 (how many 2s in 6?)

Vocabulary → divided into groups of



Shown/calculated on a number line:



- ***KS1 tends to focus on "sharing" because this is a word and a concept that children understand and also it is the picture suggested by halving.***

DIVISION

Introducing division on a number line

TU ÷ U

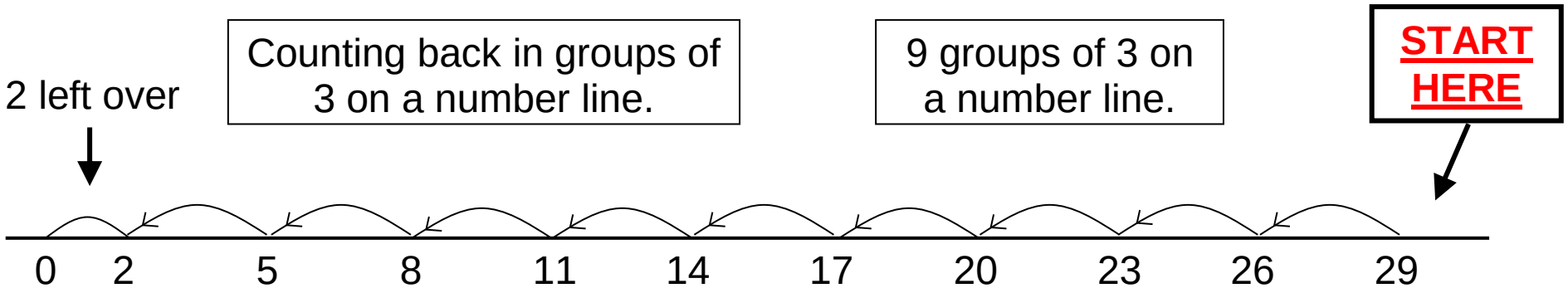
29 ÷ 3

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



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

29 ÷ 3 = 9r2

DIVISION

TU ÷ U

72 ÷ 5

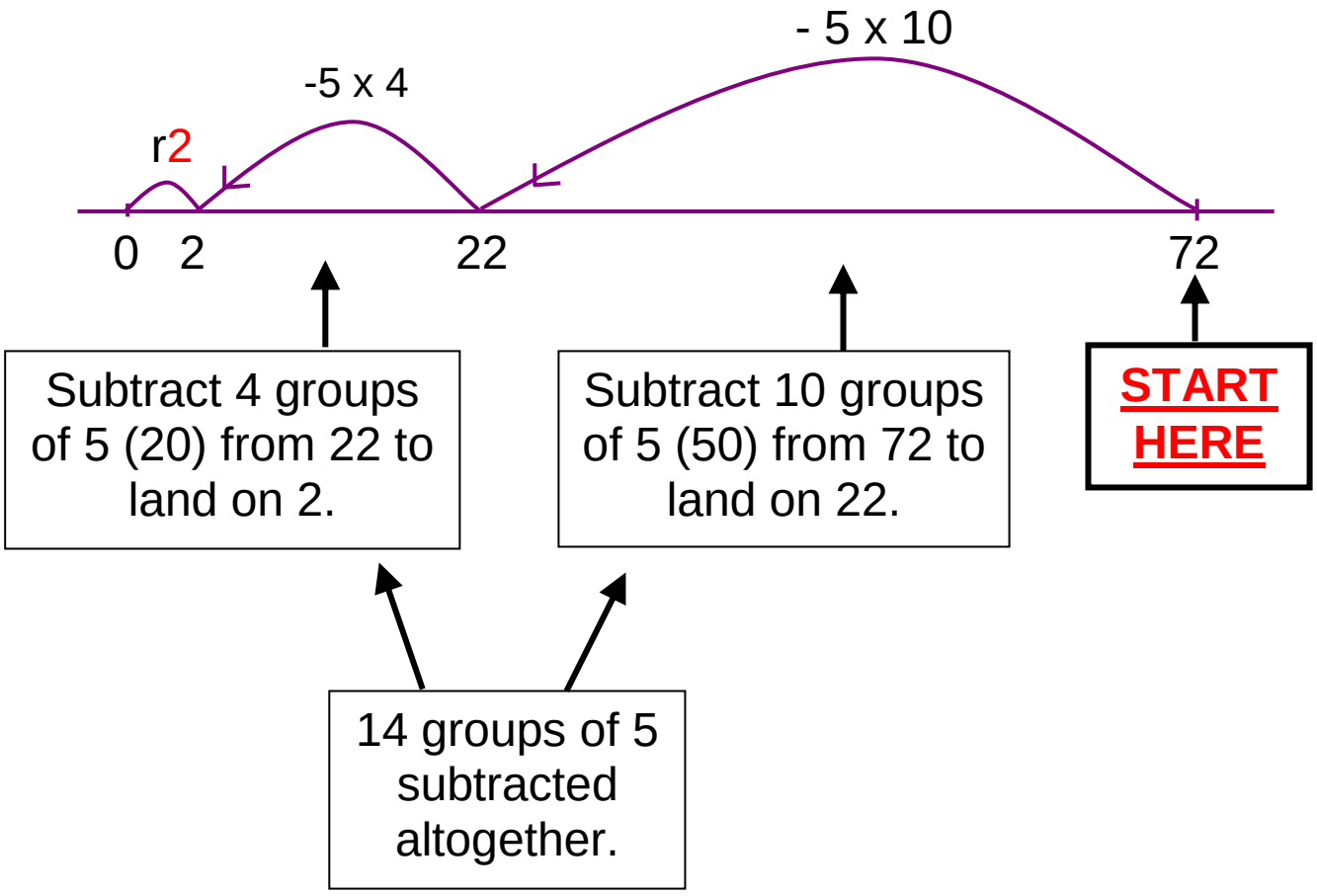
Chunking on a number line

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



2 left!
This is the *remainder*.

72 ÷ 5 = 14r2

End of Year Objectives for Division

Year 1 –practical problems that share into equal groups of 2, 5 or 10.
Year 2 –derive and recall division facts for 2, 5 or 10, represent division as repeated subtraction (grouping) and sharing. Practical and informal written methods and vocabulary used to support division, including remainders. To know that division is not commutative.
Year 3 –Practical and informal written methods for TU□U. Understand and use '3 for free' for x and □of the 2, 3, 4, 5, 6, 8 and 10 times-tables. Round remainders up or down, depending on the context.
Year 4 –Derive and recall x facts up to 12x12 and apply '3 for free' facts. Divide numbers to 1000 by 10 and 100. Develop and use formal written layouts to record.
Year 5 –Divide whole numbers and decimals by 10, 100 and 1000. Divide numbers up to 4 digits by a one digit number using the formal written methods for division and interpret remainders appropriately for the context.
Year 6 –Divide numbers up to 4 digits by a 2 digit whole number using the formal written method of long division interpreting remainders as fractions, decimals, etc. Divide numbers up to 4 digits by a two digit number using the formal written methods for division and interpret remainders appropriately for the context.

<u>As with multiplication, before progressing through the stages of calculation:</u>

Learning
- It is crucial to know or be able to derive key number facts:

⇨ Understand and use doubling and halving
⇨ ×/÷ 10 (as moving a place to the left/right NOT "add a zero" etc.!!)

- Place value and partitioning MUST be clearly understood and explained using the appropriate mathematical vocabulary.

Teaching
- The number line and the use of arrays must be modelled as images to support calculation from Reception to Year 6.
- Jottings must be modelled as a clear image/strategy for mental calculation.
- If the calculation should be possible mentally then do not give it to practise vertical calculation, e.g. 24 ÷ 3 should not be calculated using short division. Consider use of numbers carefully.

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