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# **Calculation Policy**

A guide for teachers, teaching assistants, parents and carers

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## Vocabulary

It is essential that vocabulary is used consistently and accurately throughout the school. The terms below are often misused, which can lead to misconceptions. If children use these terms, rephrase what they have said and explain why if appropriate.

sum – a sum is an additional calculation (not subtraction, multiplication or division); for any other operation, use 'calculation' or 'number sentences'

borrowing – the term borrowing in subtraction implies that the number will be returned, which it will not be. Instead use the term 'exchanging'.

adding 0 – adding zero does not change the value of a number. Teach children to say 'move one column to the left and add a placeholder', 'multiply by ten'

## Year 1

**Objectives:**

- read, write and interpret mathematical statements involving addition (+), subtraction (-) and equals (=) signs
- represent and use number bonds and related subtraction facts within 20

Pupils reason with number bonds to 10 and 20 in several forms (for example,  $9 + 7 = 16$ ;  $16 - 7 = 9$ ;  $7 = 16 - 9$ ). They should realise the effect of adding or subtracting zero. This establishes addition and subtraction as related operations.

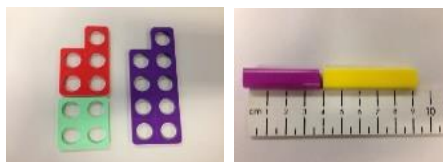
- add and subtract one-digit and two-digit numbers to 20, including zero
- solve one-step problems that involve addition and subtraction, using concrete objects and pictorial representations, and missing number problems such as  $7 = \square - 9$ .

### Addition

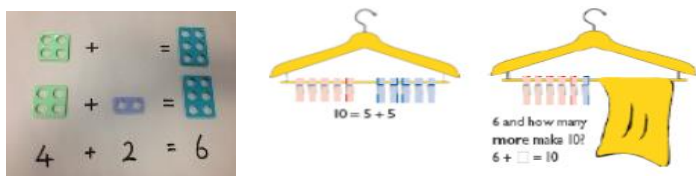
Count on from the biggest number using number tracks / number lines / 100 grids to support.



Record related number facts. e.g.  $4 + 5 = 9$ ,  $5 + 4 = 9$ ,  $9 = 4 + 5$ ,  $9 = 5 + 4$



Develop understanding of the equals sign / equality and the concept of 'empty box' questions. Record solutions to calculations such as  $4 + \square = 6$ . Children understand that each side of the equals sign must balance and that the equals sign doesn't mean 'write your answer here'.



Vocabulary: Add, plus, and, altogether, more, make, sum, combine, total, how many more to make?

### Subtraction

Count back using number tracks / number lines / 100 grids to support the development of the concept of subtraction as take away.



Develop subtraction facts initially to ten and then to 20.  
Record related number facts (and make links to related addition facts)  
e.g.  $7 - 3 = 4$ ,  $7 - 4 = 3$



Develop understanding of the equals sign / equality and the concept of 'empty box' questions.

Record solutions to calculations such as  $9 - \square = 5$ .

**Use practical apparatus e.g. counters, multilink, objects etc.**

Vocabulary: subtract, take away, minus, leave, less, left over, how many are left? How many are gone? Find the difference.

### Year 1

Objectives:

- *solve one-step problems involving multiplication and division, by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher*

Through grouping and sharing small quantities, pupils begin to understand: multiplication and division; doubling numbers and quantities; and finding simple fractions of objects, numbers and quantities.

They make connections between arrays, number patterns, and counting in twos, fives and tens.

They practise counting in twos, fives and tens from different multiples to develop their recognition of patterns in the number system (for example, odd and even numbers), including varied and frequent practice through increasingly complex questions.

#### Multiplication

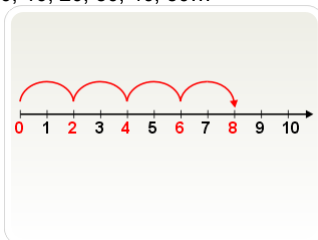
**x2, x5, x10 – Practical methods**

**Counting aloud in jumps of the above amounts – with number lines and hundred squares to support identification of patterns.**

0, 2, 4, 6, 8, 10, 12, 14...

0, 5, 10, 15, 20, 25...

0, 10, 20, 30, 40, 50...



1	2	3	4	5	6	7	8	9	10
2	4	6	8	10	12	14	16	18	20
3	6	9	12	15	18	21	24	27	30
4	8	12	16	20	24	28	32	36	40
5	10	15	20	25	30	35	40	45	50
6	12	18	24	30	36	42	48	54	60
7	14	21	28	35	42	49	56	63	70
8	16	24	32	40	48	56	64	72	80
9	18	27	36	45	54	63	72	81	90
10	20	30	40	50	60	70	80	90	100

**Repeated addition – Develop understanding that 4 lots of 3 means  $4 + 4 + 4$**



Vocabulary: Lots of, groups, repeated addition,

#### Division

Develop division as sharing – 6 shared between 2 people:



Develop division as repeated grouping (repeated subtraction of sets of the same size) using practical apparatus and diagrams.



How many sets of two stars could you make with ten stars?



5 sets.  
10 stars give five sets of two stars.

Vocabulary: Sharing into groups, fairly, equal, equally, halve, share, splitting equally, one each...two each...three each... etc.

## Year 2

**Objectives:**

- solve problems with addition and subtraction: using concrete objects and pictorial representations, including those involving numbers, quantities and measures applying their increasing knowledge of mental and written methods
- recall and use addition and subtraction facts to 20 fluently, and derive and use related facts up to 100
- add and subtract numbers using concrete objects, pictorial representations, and mentally, including: a two-digit number and ones; a two-digit number and tens; two two-digit numbers; adding three one-digit numbers
- show that addition of two numbers can be done in any order (commutative) and subtraction of one number from another cannot
- recognise and use the inverse relationship between addition and subtraction and use this to check calculations and solve missing number problems.

Pupils extend their understanding of the language of addition and subtraction to include sum and difference.

Pupils practise addition and subtraction to 20 to become increasingly fluent in deriving facts such as using  $3 + 7 = 10$ ;  $10 - 7 = 3$  and  $7 = 10 - 3$  to calculate  $30 + 70 = 100$ ;  $100 - 70 = 30$  and  $70 = 100 - 30$ . They check their calculations, including by adding to check subtraction and adding numbers in a different order to check addition (for example,  $5 + 2 + 1 = 1 + 5 + 2 = 1 + 2 + 5$ ). This establishes commutativity and associativity of addition.

Recording addition and subtraction in columns supports place value and prepares for formal written methods with larger numbers.

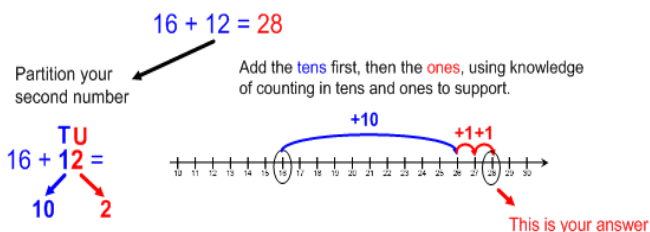
### Addition

**Develop understanding of partitioning and place value and use this to support addition.**

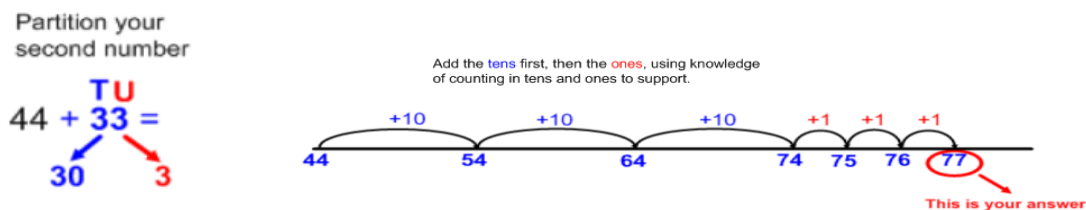
**TU + U for example:  $41 + 8$**

Children should be taught to use their knowledge of number bonds for this.

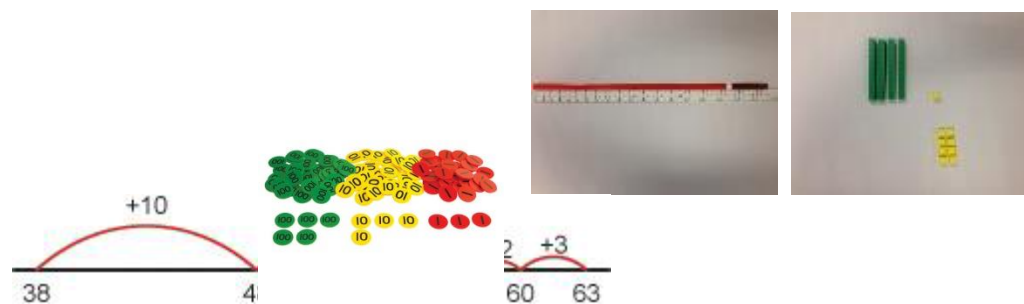
**TU + TU for example:  $16 + 12$**



**Moving on to using an empty number line to support this model of addition:**



Practical apparatus is used to support this, as are number tracks /100 squares and number lines (numbered and empty). Record the outcomes of calculations in horizontal format.





When confident with concepts of partitioning and place value, horizontal recording can be replaced with recording in columns with a focus on place value. This should be supported by the use of Dienes and place value counters.

$$\begin{array}{r} 40 + 7 \\ + 20 + 1 \\ \hline 60 + 8 = 68 \end{array}$$



Vocabulary:

Add, addition, plus, and, altogether, more, make, sum, total, increase, number line, count on, partition, inverse.

### Subtraction

Continue to use practical apparatus e.g. counter, blocks, objects etc.

Develop understanding of partitioning and place value and use this to support subtraction.

TU - U TU - TU HTU - TU

41-8 33-12 If the units are larger than the amount being subtracted 33-17

40-1-7 30-10=20 (subtract the 'tens') start from 33

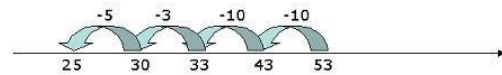
40-8=33 3-2=1 (subtract the 'units') subtract the ten 33-10=23

20+1=21 (add the two totals together) subtract the unit 23-7=16

33-12=21

Practical apparatus are used to support this, as are number tracks /100 squares and number lines (numbered and empty).

Record the outcomes of calculations in horizontal format.



$$41 - 8 = 33$$

When confident with concepts of partitioning and place value, horizontal recording can be replaced with recording in columns with a focus on place value. This should be supported by using Dienes or place value counters.

When using column subtraction, children are not expected to be 'borrowing' / exchanging in Year 2

Vocabulary:

subtract, subtraction, take away, minus, leave, less, left over, how many are left? How many are gone? Inverse, decrease, difference, fewer than. **Borrowing should not be used as a term because it implies that the borrowed number needs to go back.**

## Year 2

Objectives:

- recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables, including recognising odd and even numbers
- calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication ( $\times$ ), division ( $\div$ ) and equals ( $=$ ) signs
- show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot.
- solve problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in contexts.

Pupils use a variety of language to describe multiplication and division.

Pupils are introduced to the multiplication tables. They practise to become fluent in the 2, 5 and 10 multiplication tables and connect them to each other. They connect the 10 multiplication table to place value, and the 5 multiplication table to the divisions on the clock face.

They begin to use other multiplication tables and recall multiplication facts, including using related division facts to perform written and mental calculations.

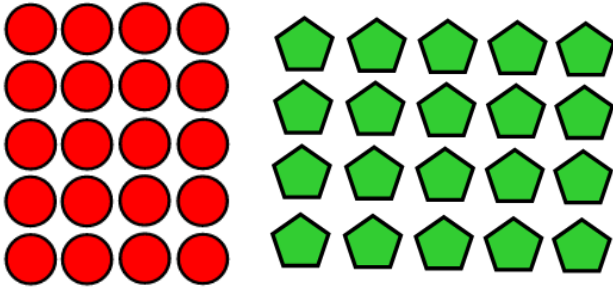
Pupils work with a range of materials and contexts in which multiplication and division relate to grouping and sharing discrete and continuous quantities, to arrays and to repeated addition. They begin to relate these to fractions and measures (for example,  $40 \div 2 = 20$ , 20 is a half of 40). They use commutativity and inverse relations to develop multiplicative reasoning (for example,  $4 \times 5 = 20$  and  $20 \div 5 = 4$ ).

### Multiplication

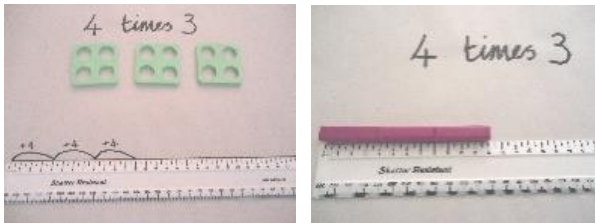
Develop an understanding of multiplication using arrays and number lines showing repeated groups.

$4 + 4 + 4 + 4 + 4$  is the same as 5 lots of 4 is the same as  $5 \times 4$

$5 + 5 + 5 + 5$  is the same as 4 lots of 5 is the same as  $4 \times 5$



Use number lines to show repeated grouping (repeated addition of sets of the same size).



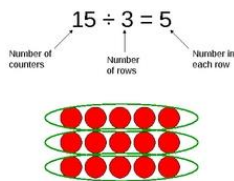
Ensure that groups of 2 and 2 lots of are also taught in these ways so that children understand that doubling is the same as multiplying by 2.

#### Vocabulary:

Lots of, groups, repeat, same size, times, multiply, jumps of, steps of, multiplied by, multiple of, array, row, column, double, repeated addition

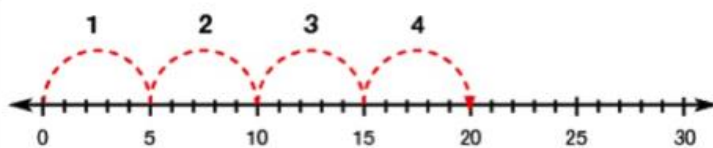
#### Division

Develop an understanding of division using arrays:



Use number lines to show repeated groupings. This should be modelled starting from zero, so that when children progress to remainders the remainder is left at the end of the number line. Initially this should be taught alongside arrays so that children can see the connection. Children need to be taught that their answer comes from counting the number of jumps.

20 divided by 5 = 4



#### Vocabulary:

sharing, share equally, into groups, fairly, equal, halve, share, one each...two each...three each... etc., divided by, divided into, left over, remainder, how many groups?

### Year 3

**Objectives:**

- add and subtract numbers mentally, including: a three-digit number and ones; a three-digit number and tens; a three-digit number and hundreds
- add and subtract numbers with up to three digits, using formal written methods of columnar addition and subtraction
- estimate the answer to a calculation and use inverse operations to check answers
- Solve problems, including missing number problems, using number facts, place value, and more complex addition and subtraction.

Pupils practise solving varied addition and subtraction questions. For mental calculations with two-digit numbers, the answers could exceed 100.

Pupils use their understanding of place value and partitioning, and practise using columnar addition and subtraction with increasingly large numbers up to three digits to become fluent.

**Addition**

Pupils continue to determine when calculations are best carried out using mental strategies.

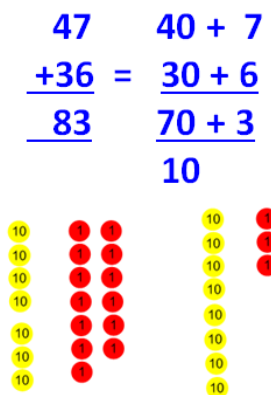
For example:  $49 + 39$  - Children should be taught to recognise that they can calculate  $50 + 40 = 90$ , then subtract  $2 = 88$

Continue to develop understanding of partitioning and place value and use this to support addition. Use practical apparatus to support this, as are number tracks /100 squares and number lines.

$$\begin{array}{r} 47 \\ +36 \\ \hline 83 \end{array} = \begin{array}{r} 40 + 7 \\ 30 + 6 \\ \hline 70 + 13 = 83 \end{array}$$



Where units combine to make totals greater than 10, regroup using partitioning skills. Place value counters should be used to support children with seeing that the 10 ones/units make one ten and that is why it moves to the tens column. When discussing this with children, use the words 'carrying a ten' instead of 'carrying a one'. Once children are secure with the expanded method, they can be moved on to the second version shown here where the total of the units is partitioned and the 10 is written under the line and added with the other numbers in the tens column.



'carry the hundred'.

$$\begin{array}{r} 322 \\ +136 \\ \hline 458 \end{array} = \begin{array}{r} 300 + 20 + 2 \\ 100 + 30 + 6 \\ \hline 400 + 50 + 8 \end{array}$$

$$\begin{array}{r} 367 \\ +185 \\ \hline 552 \end{array} = \begin{array}{r} 300 + 60 + 7 \\ 100 + 80 + 5 \\ \hline 400 + 40 + 2 \\ 100 \quad 10 \end{array}$$

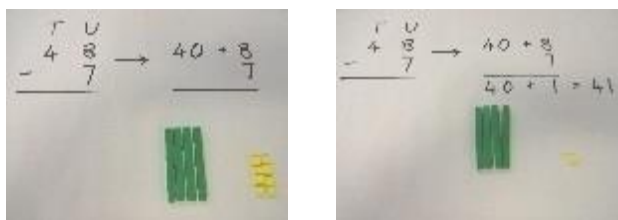
When moving on to adding HTU + HTU, use the expanded method first with place value counters, to secure conceptual understanding. Continue to use the words 'carry the ten',

**Vocabulary:**

Add, addition, plus, and, altogether, more, make, sum, total, increase, number line, count on, partition, inverse, how many more to make? How many more is \_\_\_ than \_\_\_? Hundreds, tens, units.

**Subtraction**

Continue to develop understanding of partitioning and place value and use this to support subtraction. Use practical apparatus to support this, including place value counters and Dienes.



Use expanded recording and apparatus to illustrate column subtraction clearly before moving on to the compact method. Ensure that the correct vocabulary is used. In the example below, we cannot subtract 7 from 3, so we have exchanged a ten for ten ones and moved them to the units column. Now we have 13 subtract 7, which we can do.

$$\begin{array}{r}
 60 \quad 13 \\
 73 \quad \cancel{70} + 3 \\
 -27 = \underline{20 + 7} \\
 \underline{46} \quad \underline{40 + 6}
 \end{array}$$

**Vocabulary:**

subtract, subtraction, take away, minus, decrease, leave, less, left over, how many are left/left over? How many are gone? Inverse, decrease, difference, fewer than, more than, hundreds, tens, units, boundary, how much less is \_\_\_ than \_\_\_?

**Year 3****Objectives:**

- *recall and use multiplication and division facts for the 2,3, 4, 5, 8 and 10 multiplication tables*
- *write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods*
- *solve problems, including missing number problems, involving multiplication and division, including positive integer scaling problems and correspondence problems in which n objects are connected to m objects.*

Pupils continue to practise their mental recall of multiplication tables when they are calculating mathematical statements in order to improve fluency.

Through doubling, they connect the 2, 4 and 8 multiplication tables.

Pupils develop efficient mental methods, for example, using commutativity and associativity (for example,  $4 \times 12 \times 5 = 4 \times 5 \times 12 = 20 \times 12 = 240$ ) and multiplication and division facts (for example, using  $3 \times 2 = 6$ ,  $6 \div 3 = 2$  and  $2 = 6 \div 3$ ) to derive related facts (for example,  $30 \times 2 = 60$ ,  $60 \div 3 = 20$  and  $20 = 60 \div 3$ ).

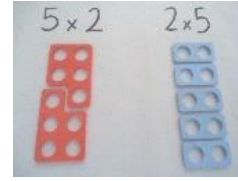
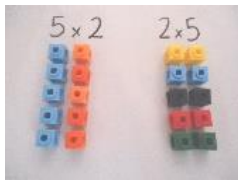
Pupils develop reliable written methods for multiplication and division, starting with calculations of two-digit numbers by one-digit numbers and progressing to the formal written methods of short multiplication and division.

Pupils solve simple problems in contexts, deciding which of the four operations to use and why. These include measuring and scaling contexts, (for example, four times as high, eight times as long etc.) and correspondence problems in which m objects are connected to n objects (for example, 3 hats and 4 coats, how many different outfits?; 12 sweets shared equally between 4 children; 4 cakes shared equally between 8 children).

**Multiplication**

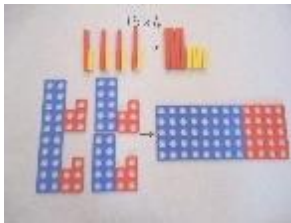
**Develop the use of x and = symbols to record calculations horizontally.**

Use arrays and other practical apparatus to illustrate commutativity (that multiplication calculations can be carried out in any order) e.g.  $2 \times 5$  arrives at the same product as  $5 \times 2$ .



Begin to derive new facts from known facts  
 e.g.  $3 \times 2 = 6$  (known fact)  
 $30 \times 2 = 60$   
 $300 \times 2 = 600$  etc.

**Begin to use understanding of place value and partitioning to carry out multiplication of two-digit by one-digit numbers**



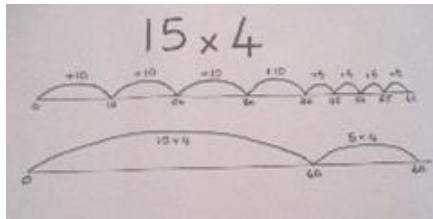
$$15 \times 4$$

$$\begin{array}{r} \downarrow \quad \searrow \\ 10 \quad 5 \end{array}$$

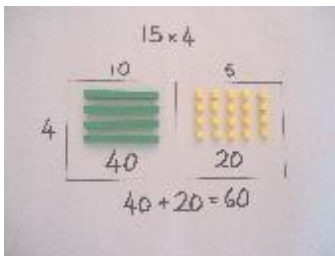
$$10 \times 4 = 40$$

$$5 \times 4 = 20$$

$$40 + 20 = 60$$



Begin to use grid approaches to illustrate as appropriate using practical apparatus to support.



X	<b>10</b>	<b>5</b>
<b>4</b>	40	20

**Vocabulary:**

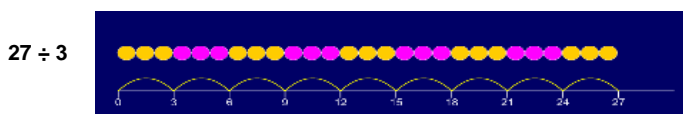
lots of, groups, repeat, same size, times, multiply, jumps of, steps of, multiplied by, multiple of, array, row, column, double, repeated addition, product, grid method.

**Division**

**Develop the use of ÷ and = symbols to record calculations horizontally**

Use arrays and other practical apparatus to illustrate making of repeated groups  
 Begin to derive new facts from known facts  
 e.g.  $6 \div 2 = 3$  (known fact)  
 $60 \div 2 = 30$   
 $600 \div 2 = 300$

**Begin to carry out division of two-digit by one-digit numbers, first without remainders, then introducing remainders, illustrating this using informal methods first if required.**



Division on a number line using larger multiples of the divisor, first with no remainders, then with remainders.



Vocabulary: sharing, equally, into groups, fairly, equal, halve, share, one each...two each...three each... etc.  
divided by, divided onto, left over, remainder, how many groups?

## Year 4

## Objectives:

- Add and subtract numbers with up to 4 digits using the formal written methods of columnar addition and subtraction where appropriate
- Estimate and use inverse operations to check answers to a calculation
- Solve addition and subtraction two-step problems in contexts, deciding which operations and methods to use and why.

Pupils continue to practise both mental methods and columnar addition and subtraction with increasingly large numbers to aid fluency.

## Addition

**Expanded column method (units first)**

$$215 + 133$$

$$\begin{array}{r} 215 \\ + 133 \\ \hline 8 \text{ (} 5 + 3 = 8 \text{)} \\ 40 \text{ (} 10 + 30 = 40 \text{)} \\ \underline{300} \text{ (} 200 + 100 = 300 \text{)} \\ 348 \end{array}$$

**Compact column**

$$215 + 133$$

OR

$$226 + 193$$

$$\begin{array}{r} 215 \\ + 133 \\ \hline 348 \end{array}$$

$$\begin{array}{r} 226 \\ + 193 \\ \hline 419 \\ \underline{\phantom{0}1} \end{array}$$

Ensure that on the middle column, children are taught to say '20 + 90' as opposed to '2 + 9' and for the hundreds column '200 + 100' instead of '2 + 1'.

## Vocabulary:

add, addition, plus, make, more, sum, total, increase, inverse, altogether, how many more to make \_\_\_? How many more is \_\_\_ than \_\_\_? Number line, partition, hundreds, tens, units, count on.

## Subtraction

**Expanded column with exchanging**

$$193 - 66$$

$$\begin{array}{r} 193 = 100 + \overset{80}{90} + \overset{13}{3} \\ - 66 = 60 + 6 \\ \hline 127 = 100 + 20 + 7 \end{array}$$

**Compact column**

$$193 - 66$$

$$\begin{array}{r} \phantom{1}^8 9^1 3 \\ - \phantom{1} \phantom{9} 66 \\ \hline 127 \end{array}$$

## Vocabulary:

subtract, subtraction take away, minus, decrease, leave, how many are left/left over? More than, fewer than, difference, tens/hundreds boundary, how much more/less is \_\_\_?, inverse.

## Year 4

## Objectives:

- recall multiplication and division facts for multiplication tables up to  $12 \times 12$
- use place value, known and derived facts to multiply and divide mentally, including: multiplying by 0 and 1; dividing by 1; multiplying together three numbers
- recognise and use factor pairs and commutativity in mental calculations
- multiply two-digit and three-digit numbers by a one-digit number using formal written layout
- solve problems involving multiplying and adding, including using the distributive law to multiply two digit numbers by one digit, integer scaling problems and harder correspondence problems such as n objects are connected to m objects.

Pupils continue to practise recalling and using multiplication tables and related division facts to aid fluency.

Pupils practise mental methods and extend this to three-digit numbers to derive facts, (for example  $600 \div 3 = 200$  can be derived from  $2 \times 3 = 6$ ).

Pupils practise to become fluent in the formal written method of short multiplication and short division with exact answers (see Mathematics Appendix 1).

Pupils write statements about the equality of expressions (for example, use the distributive law  $39 \times 7 = 30 \times 7 + 9 \times 7$  and associative law  $(2 \times 3) \times 4 = 2 \times (3 \times 4)$ ).

They combine their knowledge of number facts and rules of arithmetic to solve mental and written calculations for example,  $2 \times 6 \times 5 = 10 \times 6 = 60$ .

Pupils solve two-step problems in contexts, choosing the appropriate operation, working with increasingly harder numbers. This should include correspondence questions such as the numbers of choices of a meal on a menu, or three cakes shared equally between 10 children.

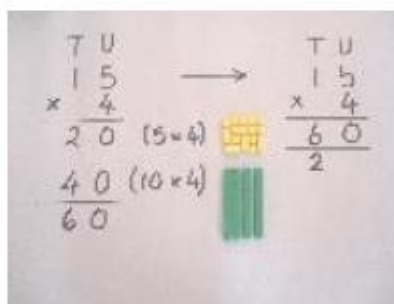
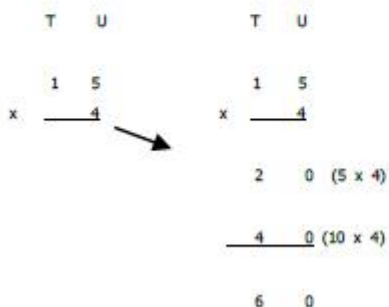
**Multiplication**

**Using the Grid Method for TU x TU**  
23 x 28

$$\begin{aligned} 400 + 60 &= 460 \\ 160 + 24 &= 184 \\ 460 + 184 &= 644 \end{aligned}$$

X	20	8	
20	400	60	
8	160	24	= 644

Develop expanded recording in columns and then move to formal written method, using practical apparatus to support as required.



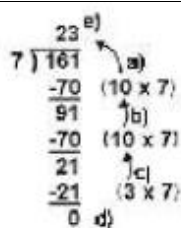
**Vocabulary:**

lots of, groups, repeat, same size, times, multiply, jumps of, steps of, multiplied by, multiple of, array, row, column, double, repeated addition, product, grid method, short multiplication.

**Division**

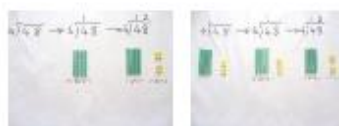
**Moving into more formal vertical method**

161 ÷ 7 =



Move to develop the standard method for short division, first with no remainders, then with remainders

48 ÷ 4



49 ÷ 4



Children will generally be moved on to the formal method of short division as soon as they are able. The other methods illustrated may be used as teaching tools to help children understand the basic concept.

Practical equipment may be used to introduce how short division works.

**Vocabulary:** sharing, share equally, into groups, fairly, equal, halve, share, divided by, divided into, left over, remainder, how many groups, factor, divisible by, chunking, inverse, quotient.



## Year 5 & 6

### Objectives:

- *add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction)*
- *add and subtract numbers mentally with increasingly large numbers*
- *use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy*
- *Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why.*

Pupils practise using the formal written methods of columnar addition and subtraction with increasingly large numbers to aid fluency

They practise mental calculations with increasingly large numbers to aid fluency (for example,  $12\,462 - 2300 = 10\,162$ ).

**In the KS2 tests at the end of Year 6, children are expected to use the formal methods for addition and subtraction.**

### Addition

Mentally (or with jottings) add larger numbers (including hundreds and thousands) or decimal amounts using partitioning and place value to support this.

$$2.9 + 1.7$$

$$2 + 1 = 3$$

$$0.9 + 0.7 = 1.6$$

$$3 + 1.6 = 4.6$$

Formal (compact column) for any number of digits, including decimals up to 2 decimal places. When adding decimals, children must be taught to keep the decimal points lined up and to use zero as a place holder to fill any gaps.

$$4837 + 2549$$

$$12.5 + 23.7$$

$$34.5 + 27.43$$

$$\begin{array}{r} 4837 \\ + 2549 \\ \hline 7386 \\ \hline 11 \end{array}$$

$$\begin{array}{r} 12.5 \\ + 23.7 \\ \hline 36.2 \\ \hline 1 \end{array}$$

$$\begin{array}{r} 34.50 \\ + 27.43 \\ \hline 61.93 \\ \hline 1 \end{array}$$

Use the expanded method as an alternative if children find the compact method difficult.

### Vocabulary:

add, addition, plus, make, more, sum, total, increase, inverse, altogether, how many more to make\_\_\_? How many more is \_\_\_ than \_\_\_? Number line, partition, hundreds, tens, units, count on.

### Subtraction

Find the difference between the two numbers by counting on on a number line from left to right. Number line should always be used in favour of formal vertical methods when subtracting between close amounts e.g.  $2008 - 1996$ . You just need to jump from 1996 to 2000 (+4), then 2000 to 2008 (+8).  $4 + 8 = 12$ , therefore  $2008 - 1996 = 12$ .

Number line should also be taught as an efficient method for calculating change (for example from £20.00)

Number line should also be taught for calculating time intervals.

Vocabulary:

subtract, subtraction take away, minus, decrease, leave, how many are left/left over? More than, fewer than, difference, tens/hundreds boundary, how much more/less is \_\_\_?

## Year 5

Objectives:

- *identify multiples and factors, including finding all factor pairs of a number, and common factors of two numbers*
- *know and use the vocabulary of prime numbers, prime factors and composite (nonprime) numbers*
- *establish whether a number up to 100 is prime and recall prime numbers up to 19*
- *multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers*
- *multiply and divide numbers mentally drawing upon known facts*
- *divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context*
- *multiply and divide whole numbers and those involving decimals by 10, 100 and 1000*
- *recognise and use square numbers and cube numbers, and the notation for squared (  $2^2$  ) and cubed (  $3^3$  )*
- *solve problems involving multiplication and division including using their knowledge of factors and multiples, squares and cubes*
- *solve problems involving addition, subtraction, multiplication and division and a combination of these, including understanding the meaning of the equals sign*
- *solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates.*

Pupils practise and extend their use of the formal written methods of short multiplication and short division (see Mathematics Appendix 1). They apply all the multiplication tables and related division facts frequently, commit them to memory and use them confidently to make larger calculations.

They use and understand the terms factor, multiple and prime, square and cube numbers.

Pupils interpret non-integer answers to division by expressing results in different ways according to the context, including with remainders, as fractions, as decimals or by rounding (for example,  $98 \div 4 = 4 \text{ r } 2 = 24 \text{ r } 2 = 24 \frac{2}{4} = 24.5 \approx 25$ ).

Pupils use multiplication and division as inverses to support the introduction of ratio in year 6, for example, by multiplying and dividing by powers of 10 in scale drawings or by multiplying and dividing by powers of a 1000 in converting between units such as kilometres and metres.

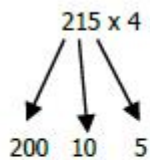
Distributivity can be expressed as  $a(b + c) = ab + ac$ .

They understand the terms factor, multiple and prime, square and cube numbers and use them to construct equivalence statements (for example,  $4 \times 35 = 2 \times 2 \times 35$ ;  $3 \times 270 = 3 \times 3 \times 9 \times 10 = 92 \times 10$ ).

Pupils use and explain the equals sign to indicate equivalence, including in missing number problems (for example,  $13 + 24 = 12 + 25$ ;  $33 = 5 \times \text{ }$ ).

Multiplication

**Extend written approaches to HTU x U, then to ThHTU x U  
Illustrate using partitioning approaches or grid approaches as required**

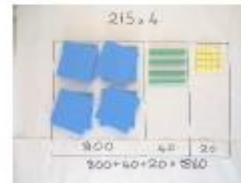


$$\begin{aligned} 200 \times 4 &= 800 \\ 10 \times 4 &= 40 \\ 5 \times 4 &= 20 \\ 800 + 40 + 20 &= 860 \end{aligned}$$



$$4 \begin{array}{|c|c|c|} \hline 200 & 10 & 5 \\ \hline 800 & 40 & 20 \\ \hline \end{array}$$

$$800 + 40 + 20 = 860$$



Develop expanded recording in columns and then move to formal written method, using practical apparatus to support as required.

	H	T	U		H	T	U
x	1	1	5	→	2	1	5
			4		4		4
		2	0		8	6	0
		4	0			2	
	8	0	0				
	8	6	0				

#### Vocabulary:

lots of, groups, repeat, same size, times, multiply, jumps of, steps of, multiplied by, multiple of, array, row, column, double, repeated addition, product, grid method, short multiplication.

#### Division

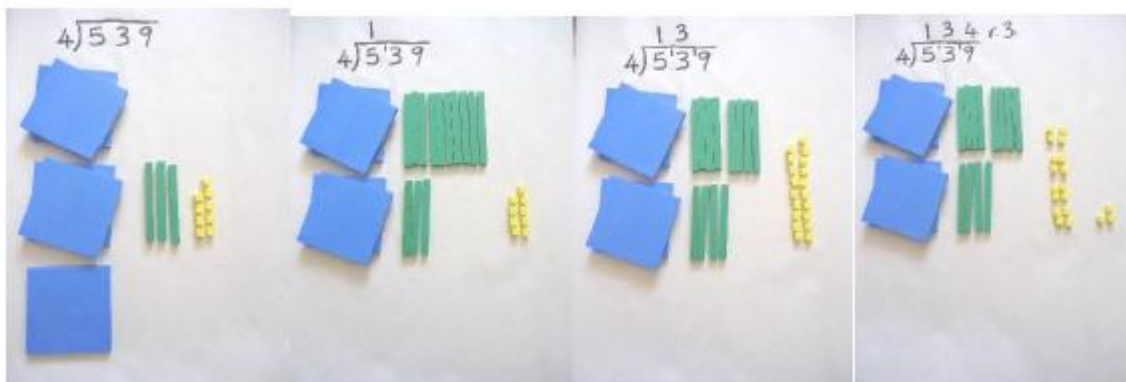
Extend written calculation methods to more complex problems involving larger numbers, firstly with no remainders.

No carrying forward required - Example:  $448 \div 4$  (as in Year 4, but with additional hundreds column)

Carrying forward required -  $536 \div 4$

Carrying forward required, but with remainders -  $539 \div 4$

Practical equipment may also be used to help children understand the process of division.



#### Vocabulary:

Sharing, share equally, into groups, fairly, equal, halve, share, divided by, divided into, left over, remainder, how many groups, factor, divisible by, divisibility, chunking, inverse, quotient.

## Year 6

### Objectives:

- multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication
- divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context
- divide numbers up to 4 digits by a two-digit number using the formal written method of short division where appropriate, interpreting remainders according to the context
- perform mental calculations, including with mixed operations and large numbers
- identify common factors, common multiples and prime numbers use their knowledge of the order of operations to carry out calculations involving the four operations
- solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why.
- solve problems involving addition, subtraction, multiplication and division
- use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.

Pupils practise addition, subtraction, multiplication and division for larger numbers, using the formal written methods of columnar addition and subtraction, short and long multiplication, and short and long division (see Mathematics Appendix 1 in the national Curriculum).

They undertake mental calculations with increasingly large numbers and more complex calculations.

Pupils continue to use all the multiplication tables to calculate mathematical statements in order to maintain their fluency.

Pupils round answers to a specified degree of accuracy, for example, to the nearest 10, 20, 50 etc., but not to a specified number of significant figures.

Pupils explore the order of operations using brackets; for example,  $2 + 1 \times 3 = 5$  and  $(2 + 1) \times 3 = 9$ . Common factors can be related to finding equivalent fractions.

**In the KS2 tests at the end of Year 6, children are expected to use the formal methods for multiplication and division.**

### Multiplication

#### Extend written approaches to HTU x TU and ThHTU x TU

Illustrate using grid approaches as required

$$26 \times 13$$

	20	6
10	200	60
3	60	18

$$200 + 60 + 60 + 18 = 338$$

Develop expanded recording in columns and then move to formal written method of long multiplication, using practical apparatus to support as required.

H   T   U	H   T   U
$\begin{array}{r} 26 \\ \times 13 \\ \hline 18 \text{ ( } 6 \times 3 \text{)} \\ 60 \text{ ( } 20 \times 3 \text{)} \\ 60 \text{ ( } 6 \times 10 \text{)} \\ \hline 200 \text{ ( } 10 \times 20 \text{)} \\ \hline 338 \end{array}$	$\begin{array}{r} 26 \\ \times 13 \\ \hline 78 \\ 1 \\ \hline 260 \\ \hline 338 \\ \hline 1 \end{array}$
→	

Develop expanded recording in columns and then move to formal method of long multiplication, using practical apparatus to support as required.

H   T   U	H   T   U
$\begin{array}{r} 226 \\ \times 13 \\ \hline 18 \text{ ( } 6 \times 3 \text{)} \\ 60 \text{ ( } 20 \times 3 \text{)} \\ 600 \text{ ( } 200 \times 3 \text{)} \\ 60 \text{ ( } 6 \times 10 \text{)} \\ 200 \text{ ( } 20 \times 10 \text{)} \\ \hline 2000 \text{ ( } 200 \times 10 \text{)} \\ \hline 2938 \end{array}$	$\begin{array}{r} 226 \\ \times 13 \\ \hline 678 \\ 1 \\ \hline 2260 \\ \hline 2938 \\ \hline 1 \end{array}$
→	

Children will generally be moved on to the formal method of short division as soon as they are able. The other methods illustrated may be used as teaching tools to help children understand the basic concept.

Practical equipment may be used to introduce how short division works.

Vocabulary:

lots of, groups, repeat, same size, times, multiply, jumps of, steps of, multiplied by, multiple of, array, row, column, double, repeated addition, product, grid method, short multiplication.

Division

**Extend written approaches to the formal method of long division when dividing by two-digit numbers, illustrating this using informal methods first if required.**

$\begin{array}{r} 28 \text{ r } 12 \\ \hline 15 \overline{) 432} \\ - 300 \text{ ( } 15 \times 20 \text{)} \\ \hline 132 \\ - 120 \text{ ( } 15 \times 8 \text{)} \\ \hline 12 \end{array}$	$\begin{array}{r} 28 \text{ r } 12 \\ \hline 15 \overline{) 432} \\ \underline{30} \\ 132 \\ \underline{120} \\ 12 \end{array}$
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Vocabulary:

Sharing, share equally, into groups, fairly, equal, halve, share, divided by, divided into, left over, remainder, how many groups, factor, divisible by, divisibility, chunking, inverse, quotient.

## Mathematics Appendix 1: Examples of formal written methods for addition, subtraction, multiplication and division

This appendix sets out some examples of formal written methods for all four operations to illustrate the range of methods that could be taught. It is not intended to be an exhaustive list, nor is it intended to show progression in formal written methods. For example, the exact position of intermediate calculations (superscript and subscript digits) will vary depending on the method and format used.

For multiplication, some pupils may include an addition symbol when adding partial products. For division, some pupils may include a subtraction symbol when subtracting multiples of the divisor.

### Addition and subtraction

789 + 642 becomes

$$\begin{array}{r} 789 \\ + 642 \\ \hline 1431 \\ \hline 1 \quad 1 \end{array}$$

Answer: 1431

874 – 523 becomes

$$\begin{array}{r} 874 \\ - 523 \\ \hline 351 \end{array}$$

Answer: 351

932 – 457 becomes

$$\begin{array}{r} \phantom{0}^8 \phantom{0}^{12} \phantom{0}^1 \\ 932 \\ - 457 \\ \hline 475 \end{array}$$

Answer: 475

932 – 457 becomes

$$\begin{array}{r} \phantom{0}^1 \phantom{0}^1 \\ 932 \\ - 457 \\ \hline 475 \end{array}$$

Answer: 475

### Short multiplication

24 × 6 becomes

$$\begin{array}{r} 24 \\ \times 6 \\ \hline 144 \\ \hline 2 \end{array}$$

Answer: 144

342 × 7 becomes

$$\begin{array}{r} 342 \\ \times 7 \\ \hline 2394 \\ \hline 2 \quad 1 \end{array}$$

Answer: 2394

2741 × 6 becomes

$$\begin{array}{r} 2741 \\ \times 6 \\ \hline 16446 \\ \hline 4 \quad 2 \end{array}$$

Answer: 16 446

**Long multiplication**

24 × 16 becomes

$$\begin{array}{r} \phantom{0}2 \\ 24 \\ \times 16 \\ \hline 240 \\ 144 \\ \hline 384 \end{array}$$

Answer: 384

124 × 26 becomes

$$\begin{array}{r} \phantom{00}12 \\ 124 \\ \times \phantom{0}26 \\ \hline 2480 \\ 744 \\ \hline 3224 \\ \phantom{00}11 \end{array}$$

Answer: 3224

124 × 26 becomes

$$\begin{array}{r} \phantom{00}12 \\ 124 \\ \times \phantom{0}26 \\ \hline 744 \\ 2480 \\ \hline 3224 \\ \phantom{00}11 \end{array}$$

Answer: 3224

**Short division**

98 ÷ 7 becomes

$$\begin{array}{r} \phantom{0}14 \\ 7 \overline{) 98} \\ \underline{7} \phantom{0} \\ \phantom{0}28 \\ \underline{28} \\ \phantom{00}0 \end{array}$$

Answer: 14

432 ÷ 5 becomes

$$\begin{array}{r} \phantom{00}86 \text{ r } 2 \\ 5 \overline{) 432} \\ \underline{40} \phantom{0} \\ \phantom{0}32 \\ \underline{30} \\ \phantom{00}2 \end{array}$$

Answer: 86 remainder 2

496 ÷ 11 becomes

$$\begin{array}{r} \phantom{00}45 \text{ r } 1 \\ 11 \overline{) 496} \\ \underline{44} \phantom{0} \\ \phantom{0}56 \\ \underline{55} \\ \phantom{00}1 \end{array}$$

Answer:  $45 \frac{1}{11}$ **Long division**

432 ÷ 15 becomes

$$\begin{array}{r} \phantom{00}28 \text{ r } 12 \\ 15 \overline{) 432} \\ \underline{30} \phantom{0} \\ \phantom{0}132 \\ \underline{150} \\ \phantom{00}12 \end{array}$$

Answer: 28 remainder 12

432 ÷ 15 becomes

$$\begin{array}{r} \phantom{00}28 \\ 15 \overline{) 432} \\ \underline{30} \phantom{0} \\ \phantom{0}132 \\ \underline{150} \\ \phantom{00}12 \end{array} \begin{array}{l} 15 \times 20 \\ 15 \times 8 \end{array}$$

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

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

432 ÷ 15 becomes

$$\begin{array}{r} \phantom{00}28.8 \\ 15 \overline{) 432.0} \\ \underline{30} \phantom{0} \\ \phantom{0}132 \\ \underline{150} \\ \phantom{00}120 \\ \underline{150} \\ \phantom{000}0 \end{array}$$

Answer: 28.8