

Gordon Primary School

Calculation Policy

Revised Spring Term 2024

Signed _____ Chair of Governors

To be reviewed Spring Term 2025

Mental methods for calculation

At Gordon Primary School, we teach children to use the following mental calculations:

Addition and subtraction skills and strategies:

Counting forwards and backwards

Reordering

Partitioning (i) Using multiples of 10 and 100

Partitioning (ii) Bridging through multiples of 10

Partitioning (iii) Compensating

Partitioning (iv) Using 'near' doubles

Partitioning (v) Bridging through numbers other than 10

Multiplication and division skills and strategies:

Knowing multiplication and division facts to 10

Multiplying and dividing by multiples of 10

Multiplying and dividing by single-digit numbers and multiplying by two-digit numbers

Doubling and halving

Fractions, decimals and percentages

Mental calculation expectations for each year:

	Rapid recall Children should be able to recall rapidly:	Mental strategies Children should be able to use the following strategies, as appropriate, for mental calculations:	Mental calculations Children should be able to use mental calculations to:
Year 1	<u>Recall:</u> - all pairs of numbers (including number bonds) with a total of up to 20, e.g. $13 + 7$ - addition and subtraction facts for all numbers within 20 - addition doubles of all numbers to at least 10, e.g. $7 + 7$ <u>Derive:</u> - multiples of 2, 5 and 10 (up to the twelfth multiple)	- count from 0 to and across 100, forward and backwards, beginning with 0 or 1, and from any given number - recognise place value in numbers beyond 20 by counting and comparing numbers up to 100. - reorder numbers in a calculation (see appendix 1) - begin to bridge through 10 and later 20 when adding a single-digit number (see appendix 2) - use number facts and place value to add or subtract pairs of single-digit numbers - add 9 to single-digit numbers by adding 10 then subtracting 1 - identify near doubles using doubles already known - use patterns of similar calculations - count in different multiples including ones, twos, fives and tens	- add or subtract a single-digit to or from a single-digit, without crossing 10, e.g. $4 + 5$, $8 - 3$ - add or subtract a single-digit to or from 10 - add or subtract a single-digit to or from a 'teens' number, without crossing 20 or 10, e.g. $13 + 5$, $17 - 3$ - add and subtract numbers to 20 in the three forms (e.g. $9 + 7 = 16$; $16 - 7 = 9$; $16 - 9 = 7$) - double numbers to 10, e.g. $9 + 9 = 18$

Mental calculation expectations for each year:

	Rapid recall Children should be able to recall rapidly: 2,5 and 10 times tables	Mental strategies Children should be able to use the following strategies, as appropriate, for mental calculations:	Mental calculations Children should be able to use mental calculations to:
Year 2	<u>Recall:</u> - addition and subtraction facts to 20 e.g. $13 + 7$ or $12 + 6$ - all pairs of multiples of 10, with a total of up to 100, e.g. $30 + 70$ or $10 + 50$ - multiplication facts for the 2, 5 and 10 times-tables and corresponding division facts - doubles of all numbers to 20 and the corresponding halves	- count on or back in ones or tens from any number up to 100 - recognise place value in numbers by counting and comparing numbers to at least 100. - practise addition and subtraction of number bonds to 20 using related facts to perform calculations (e.g. using $3 + 7 = 10$, $10 - 7 = 3$ and $10 - 3 = 7$ to calculate $30 + 70 = 100$, $100 - 70 = 30$ and $100 - 30 = 70$). - find a small difference by counting up from the smaller to the larger number - reorder numbers in a calculation (see appendix 1) - add three small numbers by putting the largest number first and/or finding a pair totalling 20 - partition additions into tens and units then recombine (see appendix 3) - bridge through 10 or 20 (see appendix 2) - use known number facts and place value to add or subtract pairs of numbers - partition into '5 and a bit' when adding 6, 7, 8 or 9 - add or subtract 9, 19, 11 or 21 by rounding and compensating (see appendix 4) - identify near doubles - use patterns of similar calculations - use the relationship between addition/subtraction - use knowledge of number facts and place value to multiply or divide by 2, 5 or 10 - practise recalling multiplication tables and related division facts - practise multiplying in any order (commutatively) - count in steps of 2, 3, 5 and 10 - use doubles and halves and halving as the inverse of doubling	- add or subtract any single-digit to or from any two-digit number, without crossing the tens boundary, e.g. $62 + 4$, $38 - 7$ - add or subtract any single-digit to or from a multiple of 10, e.g. $60 + 5$, $80 - 7$ - add or subtract any 'teens' number to any two-digit number, without crossing the tens boundary, e.g. $23 + 14$, $48 - 13$ - find what must be added to any two-digit multiple of 10 to make 100, e.g. $70 + ? = 100$ - add or subtract a multiple of 10 to or from any two-digit number, without crossing 100, e.g. $47 + 30$, $82 - 50$ - subtract any two-digit number from any two-digit number when the difference is less than 10, e.g. $78 - 71$ or $52 - 48$ - doubles of all numbers to at least 20, e.g. double 19 - double any multiple of 5 up to 50, e.g. double 35 - halve any multiple of 10 up to 100, e.g. halve 50

Mental calculation expectations for each year:

	Rapid recall Children should be able to recall rapidly: 2, 5 and 10 times tables	Mental strategies Children should be able to use the following strategies, as appropriate, for mental calculations:	Mental calculations Children should be able to use mental calculations to:
Year 3	<u>Recall:</u> • sums and differences of multiples of 10, e.g. $70 + 20$ or $80 - 30$ • number pairs that total 100, e.g. $46 + 54$ • multiplication facts for the 2, 3, 4, 5, 8 and 10 times tables and the corresponding division facts	• count on or back in hundreds, tens or ones up to 1000 • find difference by counting up from the smaller to the larger number • reorder numbers in a calculation (see appendix 1) • add three or four small numbers by putting the largest number first and/or by finding pairs totalling e.g. 19, 20 or 21 • partition into tens and units then recombine (see appendix 3) • bridge through a multiple of 10, 100, then adjust (see appendix 2) • use knowledge of number facts and place value to add or subtract pairs of numbers 2-digit numbers, where answers exceed 100. • partition into '5 and a bit' when adding 6, 7, 8 or 9 • add or subtract mentally a 'near multiple of 10' to or from a two-digit number • identify near doubles • use patterns of similar calculations • say or write a subtraction statement corresponding to a given addition statement • to multiply a number by 10/100, shift its digits one/two places to the left • use knowledge of number facts and place value to multiply or divide by 2, 5 or 10, 100 • use doubling or halving • say or write a division statement corresponding to a given multiplication statement • to practise regularly the mental recall of multiplication tables when calculating mathematical statements until confident. • count in multiples of 2, 3, 4, 5, 8, 10, 50 and 100 from 0 • develop efficient mental methods. For example, use commutativity (e.g. $4 \times 12 \times 5 = 4 \times 5 \times 12 = 20 \times 12 = 240$) and multiplication and division facts (e.g. using $3 \times 2 = 6$, $6 \div 3 = 2$ and $2 = 6 \div 3$ to calculate $30 \times 2 = 60$, $60 \div 3 = 20$ and $20 = 60 \div 3$).	• accurately add and subtract numbers mentally including: pairs of one- and 2-digit numbers; 3-digit numbers and ones; 3-digit numbers and tens; 3-digit numbers and hundreds • find what must be added to any multiple of 100 to make 1000, e.g. $300 + ? = 1000$ • add or subtract any pair of two-digit numbers, without crossing a tens boundary or 100, e.g. $33 + 45$, $87 - 2$ • add or subtract any single-digit to any two-digit number, including crossing the tens boundary, e.g. $67 + 5$, $82 - 7$ • find what must be added to/subtracted from any two-digit number to make the next higher/lower multiple of 10. e.g. $64 + ? = 70$, $56 - ? = 50$ • subtract any three-digit number from any three-digit number when the difference is less than 10, e.g. $458 - 451$, or $603 - 597$ • find what must be added to/subtracted from any three-digit number to make the next higher/lower multiple of 10, e.g. $647 + ? = 650$, $246 - ? = 240$ • double any number to at least 20, e.g. double 18, and corresponding halves, e.g. halve 36; double 60, halve 120; double 35, halve 70; double 450, halve 900 • multiply single-digit numbers by 10 or 100, e.g. 6×100 • divide any multiple of 10 by 10, e.g. $60 \div 10$, and any multiple of 100 by 100, e.g. $700 \div 100$

Mental calculation expectations for each year:

	Rapid recall Children should be able to recall rapidly:	Mental strategies Children should be able to use the following strategies, as appropriate, for mental calculations:	Mental calculations Children should be able to use mental calculations to:
Year 4	<u>Recall:</u> - place value facts for each digit in a 4-digit number (thousands, hundreds, tens, and ones) <u>Derive:</u> - sums and differences of pairs of multiples of 10, 100 or 1000 - doubles of multiples of 10 and 100 and corresponding halves <u>Recall:</u> - multiplication facts up to 12×12 and the corresponding division facts - multiples of numbers to 12 up to the twelfth multiple	- count on or back in repeated steps of 1, 10 and 100 - count up through the next multiple of 10, 100 or 1000 - order and compare numbers up to 10,000 - reorder numbers in a calculation (see appendix 1) - add 3 or 4 numbers, finding pairs totalling 100 - add three two-digit multiples of 10 - partition into tens and units, adding the tens first (see appendix 3) - bridge through 100 and 1000 (see appendix 2) - use knowledge of number facts and place value to add or subtract any pair of two-digit and three digit numbers - add or subtract numbers e.g. 9, 19, 29, 11, 21 or 31 by rounding and compensating (see appendix 4) - add or subtract the nearest multiple of 10 then adjust - identify near doubles - continue to use the relationship between addition and subtraction - double any two-digit number by doubling tens first - use known number facts and place value to multiply or divide, including multiplying and dividing by 10 and then 100 - partition to carry out multiplication - use doubling or halving - use closely related facts to carry out multiplication and division - use the relationship between multiplication and division - count in multiples of 2, 3, 4, 5, 6, 7, 8, 9, 10, 25, 50, 100 and 1000 from any given number, and 10 or 100 more or less than a given number - practise recalling and using multiplication tables and related division facts on a regular basis until confident using them mentally. - practise multiplying using mental methods and extend this to 3-digit numbers to derive facts, for example $300 \times 2 = 600$ into $600 \div 3 = 200$. - use the distributive law to derive facts, for example, $30 \times 7 + 9 \times 7 = 39 \times 7$.	- find what must be added to any two-digit number to make 100, e.g. $37 + ? = 100$ - add or subtract any pair of two-digit numbers, e.g. $38 + 85$, $92 - 47$ - find out what must be added to/subtracted from any two- or three-digit number to make the next higher/lower multiple of 100, e.g. $374 + ? = 400$, $826 - ? = 800$ - subtract any four-digit number from any four-digit number when the difference is small, e.g. $3641 - 3628$, $6002 - 5991$ - add and subtract multiples of 100 with increasingly large numbers, for example, $12,462 - 2,400 = 10,062$ or $12,462 + 600 = 13,062$. - double any whole number from 1 to 50, e.g. double 36, and find all the corresponding halves, e.g. $96 \div 2$ - double any multiple of 10 and 100 to 1000, e.g. 380×2, and find all the corresponding halves, e.g. $760 \div 2$, $130 \div 2$ - double any multiple of 5 to 100, e.g. 65×2 - multiply any two-digit number by 10 and 100, e.g. 26×10 - divide a multiple of 100 by 10 or 100, e.g. $600 \div 10$ - multiply any two-digit multiple of 10 by any single-digit number

Mental calculation expectations for each year:

	Rapid recall Children should be able to recall rapidly:	Mental strategies Children should be able to use the following strategies, as appropriate, for mental calculations:	Mental calculations Children should be able to use mental calculations to:
Year 5	<u>Recall:</u> - place value facts for numbers up to 1,000,000 <u>Derive:</u> - sums and differences of decimals, e.g. 6.5 ± 2.7 - doubles and halves of decimals, e.g. half of 5.6 <u>Recall:</u> - prime numbers up to 19	- count forwards or backwards in steps of 100, 1000 or 10,000 for any given number up to 1,000,000 - reorder numbers in a calculation (see appendix 1) - practise reading and saying regularly the place value of each digit in up to six digit numbers, including decimals. - partition into thousands, hundreds, tens and units, adding the most significant digit first (see appendix 3) - use known number facts and place value to add or subtract pairs of three-digit multiples of 10 and two-digit numbers with one decimal place - add or subtract the nearest multiple of 10 or 100 then adjust - identify near doubles - add several numbers - develop further the relationship between addition and subtraction - practise fast responses for mental calculations with increasingly large numbers, for example: $12,462 - 2,300 = 10,162$. - practise counting forwards and backwards using decimal fractions, and mental addition and subtraction of tenths and 1 digit whole numbers and tenths. - practise identify multiples including common multiples, and factors including common factors - use factors - partition to carry out multiplication - use doubling and halving - use closely related facts to carry out multiplication and division - use knowledge of number facts and place value to multiply or divide - practise and apply all the multiplication tables and related division facts to make larger calculations. - accurately multiply and divide numbers mentally drawing upon known facts - multiply and divide numbers by 10, 100 and 1000	- add and subtract numbers mentally with increasingly large numbers. - add or subtract any pair of three-digit multiples of 10, e.g. $570 + 250$, $620 - 380$ - find what must be added to a decimal fraction with units and tenths to make the next higher whole number, e.g. $4.3 + ? = 5$ - add or subtract any pair of decimal fractions each with units and tenths, or each with tenths and hundredths, e.g. $5.7 + 2.5$, $0.63 - 0.48$ - subtract a four-digit number just less than a multiple of 1000 from a four-digit number just more than a multiple of 1000, e.g. $5001 - 1997$ - subtract with increasing large numbers e.g. $12,462 - 2,300 = 10,162$. - multiply any two- or three-digit number by 10 or 100, e.g. 79×100, 363×100 - divide a multiple of 100 by 10 or 100, e.g. $4000 \div 10$, $3600 \div 100$ - multiply any two-digit multiple of 10 by a single-digit, e.g. 60×7, 90×6 - double any whole number from 1 to 100, multiples of 10 to 1000, and find corresponding halves - find 50%, 25%, 10% of small whole numbers or quantities, e.g. 25% of £8

Mental calculation expectations for each year:

	Rapid recall Children should be able to recall rapidly:	Mental strategies Children should be able to use the following strategies, as appropriate, for mental calculations:	Mental calculations Children should be able to use mental calculations to:
Year 6	<u>Recall:</u> place value facts for numbers up to 10 million <u>Derive:</u> • multiplication and division facts involving decimals, e.g. 0.8×7 and $4.8 \div 6$ • squares of numbers to 12 x 12 and the corresponding squares of multiples of 10 • recall place value facts for each digit to three decimal places and multiply and divide numbers up to three decimal place by 10, 100 and 1000 • recall and use equivalences between fractions, decimals and percentages.	• consolidate all strategies from previous years • use knowledge of number facts and place value to add or subtract pairs of three-digit multiples of 10 and two-digit numbers with one decimal place • add or subtract the nearest multiple of 10, 100 or 1000, then adjust • continue to use the relationship between addition and subtraction • use factors • to practise fast responses for mental calculations with increasingly large numbers and more complex calculations. • practise mental calculations, including with mixed operations and large numbers • partition to carry out multiplication • use doubling and halving • use closely related facts to carry out multiplication and division • use the relationship between multiplication and division • use knowledge of number facts and place value to multiply or divide • to use all the multiplication tables to calculate mathematical statements to maintain fluency • to multiply decimals by whole numbers starting with the simplest cases, such as $0.4 \times 2 = 0.8$, and practical contexts, such as measures and money • practise division of decimal numbers initially in practical contexts involving measures and money and by single digit whole numbers. • to practise calculating and indentifying equivalent fractions of a percentage e.g. 62% is equivalent to 62/100 and 0.62	• add and subtract negative integers • subtract with increasing large numbers e.g. $12,462 - 2,351 = 10,111$. • multiply any two-digit number by a single-digit, e.g. 34×6 • multiply any two-digit number by 50 or 25, e.g. 23×50, 47×25 • multiply or divide any whole number by 10 or 100, giving any remainder as a decimal, e.g. $47 \div 10 = 4.7$, $1763 \div 100 = 17.63$ • find squares of multiples of 10 to 100 • find any multiple of 10% of a whole number or quantity, e.g. 70% of £20, 50% of 5kg, 20% of 2 metres

Written methods for calculation

Mental calculation is not at the exclusion of written recording and should be seen as complementary to and not as separate from it. In every written method there is an element of mental processing.

Pupils should be taught to use the most efficient written method, only using this when mental strategies and inefficient.

Written recording both helps children to clarify their thinking and supports and extends the development of more fluent and sophisticated mental strategies.

Although each method will be taught in the year group specified, children should not be discouraged from using previously taught methods with which they are secure, while the new concepts are becoming embedded.

The long-term aim is for children to be able to select an efficient method of their choice that is appropriate for a given task. They should do this by always asking themselves:

'Can I do this in my head?'

'Can I do this in my head using drawings or jottings?'

'Do I need to use a written method?'

Written methods for addition of whole numbers

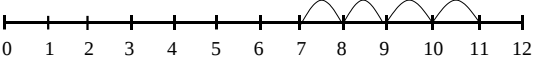
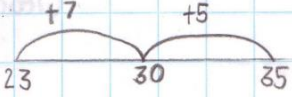
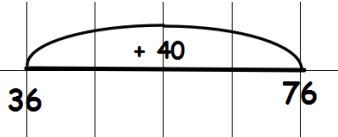
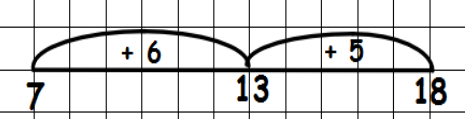
The aim is that children use mental methods when appropriate, but for calculations that they **cannot** do in their heads they use an efficient written method accurately and with confidence. Children are entitled to be taught and to acquire secure mental methods of calculation and one efficient written method of calculation for addition which they know they can rely on when mental methods are not appropriate.

To add successfully, children need to be able to:

- recall all addition pairs to $9 + 9$ and complements in 10;
- add mentally a series of one-digit numbers, such as $5 + 8 + 4$;
- add multiples of 10 (such as $60 + 70$) or of 100 (such as $600 + 700$) using the related addition fact, $6 + 7$, and their knowledge of place value;
- partition two-digit and three-digit numbers into multiples of 100, 10 and 1 in different ways

Note: *It is important that children's mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for addition.*

WRITTEN METHODS FOR ADDITION ~ PROGRESSION FROM Y1-Y3

Year One $O + O$ $TO + O$ and $TO + TO$ (numbers up to 20)	Year Two $O + O$ $TO + O$ $TO + T$ $O + O + O$ $TO + TO$ (Add with 2-digit numbers – no crossing over)	Year Three $TO + TO$, developing to $HTO + TO$ or $HTO + HTO$ (Add numbers with up to 3-digits - Crossing the tens boundary, or hundreds boundary).
+ = signs and missing numbers Children need to understand the concept of equality before using the '=' sign. Calculations should be written either side of the equality sign so that the sign is not just interpreted as 'the answer'. $2 = 1 + 1$ $2 + 3 = 4 + 1$ $3 = 3$ $2 + 2 + 2 = 4 + 2$ Missing numbers need to be placed in all possible places. $3 + 4 = \square$ $\square = 3 + 4$ $3 + \square = 7$ $7 = \square + 4$ $\square + 4 = 7$ $7 = 3 + \square$ $\square + \nabla = 7$ $7 = \square + \nabla$ The Number Line (counting in 1s) Children use a numbered line to count on in ones. Children use number lines and practical resources to support calculation and teachers <i>demonstrate</i> the use of the number line. $7 + 4 = 11$  $7 + 4 = 11$	+ = signs and missing numbers Continue using a range of equations as in Year 1 but with appropriate, larger numbers. Extend to: $14 + 5 = 10 + \square$ and $32 + \square + \square = 100$ $35 = 1 + \square + 5$ The Empty Number Line: Bridging through multiple of 10. The steps in addition often bridge through a multiple of 10 e.g. Children should be able to partition the 7 to relate adding the 2 and then the 5. $23 + 12 = 35$  $36 + 40 = 76$  $7 + 6 + 5 = 18$ 	+ = signs and missing numbers Continue using a range of equations as in Year 1 and 2 but with appropriate, larger numbers. The Empty Number Line: counting on in tens and units. Column addition (carrying over) $\begin{array}{r} 29 \\ +135 \\ \hline 164 \end{array}$ <i>*Revert back to column addition which does not involve carrying over, if needed (See Yr 2).</i> Partition into tens and ones and recombine Partition both numbers and recombine. $36 + 53$ $30 + 50 = 80$ $30 + 6 + 50 + 3$ $3 + 6 = 9$ $= 30 + 50 + 6 + 3$ $80 + 9 = 89$ $= 80 + 9 = 89$ Expanded column addition (carrying over) $67 + 85$ $\begin{array}{r} 60 + 7 \\ 80 + 5 \\ \hline 140 + 12 \\ \hline 152 \end{array}$ $140 + 10 + 2 = 152$



This method should be introduced in the **Spring Term** of Year 2:

Column addition (questions which do not involve carrying over)

$$\begin{array}{r} 23 \\ + 35 \\ \hline 58 \end{array}$$

Non statutory: (questions which do involve carrying over)

$$16 + 25 = 41$$

	1		
	1	6	
+	2	5	
	4	1	

If children are unable to understand column method do the methods below (partition & expanded) first to explain place value.

Partition into tens and ones and recombine

$$\begin{aligned} 12 + 23 &= 10 + 2 + 20 + 3 & 10 + 20 + 2 + 3 &= 35 \\ &= 30 + 5 \\ &= 35 \end{aligned}$$

Expanded column addition (questions which do not involve carrying over) e.g. $23 + 35 =$

$$\begin{array}{r} 23 \quad 20 + 3 \\ + 35 \quad \underline{30 + 5} \\ 50 + 8 = 58 \end{array}$$

If children are unable to understand column method do the method below first, to explain place value.

Expanded column addition (carrying over)

e.g. $367 + 185 = 552$

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

4	0	0	+	1	4	0	+	1	0	+	2	=	5	5	2
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WRITTEN METHODS FOR ADDITION ~ PROGRESSION FROM Y4 - Y6

Year Four	Year Five	Year Six																																																																																																																																									
Add up to 4 digits HTO + HTO/ ThHTO + HTO/ ThHTO + ThHTO and £.p (Crossing the tens boundary, or hundreds boundary, or both).	Add up to 5 digits including using formal written methods and decimals with up to two places.	ThHTU + ThHTU, then numbers with any number of digits and decimals (any decimal places)																																																																																																																																									
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Column addition (carrying over) 3587 + 675 = 4262	Column addition (carrying over)	Column addition (carrying over) (Adding several numbers with more than 4 digits.)																																																																																																																																									
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	<i>*Revert back to column addition which does not involve carrying over or expanded column method (See Year 4), if needed.</i>	<i>*Revert to expanded method if needed (see previous years)</i>																																																																																																																																									

Written methods for subtraction of whole numbers

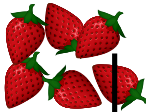
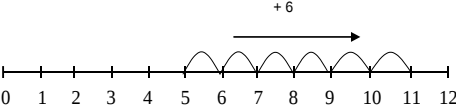
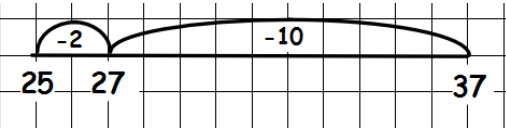
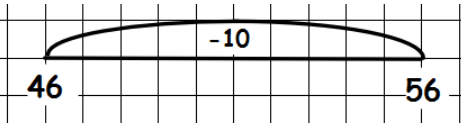
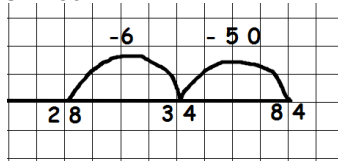
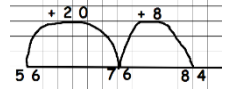
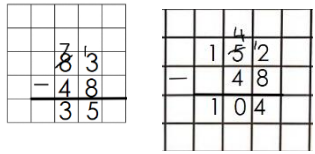
The aim is that children use mental methods when appropriate, but for calculations that they **cannot** do in their heads they use an efficient written method accurately and with confidence. Children are entitled to be taught and to acquire secure mental methods of calculation and one efficient written method of calculation for subtraction which they know they can rely on when mental methods are not appropriate.

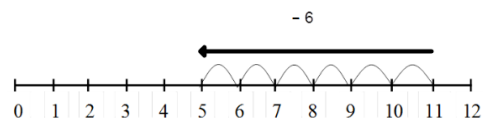
To subtract successfully, children need to be able to:

- recall all addition and subtraction facts to 20;
- subtract multiples of 10 (such as $160 - 70$) using the related subtraction fact $16 - 7$, and their knowledge of place value;
- partition two-digit and three-digit numbers into multiples of one hundred, ten and one in different ways (e.g. partition 74 into $70 + 4$ or $60 + 14$).

Note: *It is important that children's mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for subtraction.*

WRITTEN METHODS FOR SUBTRACTION ~ PROGRESSION FROM Y1 – Y3

Year One O - O TO - O and TO - TO	Year Two O - O TO - O TO - T TO - TO	Year Three TO - TO, developing to HTO - TO or HTO - HTO
- = signs and missing numbers $7 - 3 = \square \quad \square = 7 - 3$ $7 - \square = 4 \quad 4 = \square - 3$ $\square - 3 = 4 \quad 4 = 7 - \square$ $\square - \nabla = 4 \quad 4 = \square - \nabla$ Understand subtraction as 'take away' Use practical methods to support the subtraction of a one-digit number from a one digit or two-digit number and a multiple of 10 from a two-digit number. $6 - 1 = 5$  Number line: Find a 'difference' by counting up in 1s: Use informal written methods to support the subtraction of a one-digit number from a one digit or two-digit number and a multiple of 10 from a two-digit number. <i>I have saved 5p. The socks that I want to buy cost 11p. How much more do I need in order to buy the socks?</i>  <i>Additionally, use the number line showing subtraction.</i>	- = signs and missing numbers Continue using a range of equations as in Year 1 but with appropriate numbers. Extend to $14 + 5 = 20 - \square$ The Empty Number Line for finding difference by counting up: Bridging through multiple of 10 $37 - 12 = 25$  $56 - 10 = 46$  Partitioning: Use known number facts and place value to subtract (partition number to be subtracted only) $37 - 12 = 37 - 10 - 2$ $= 27 - 2$ $= 25$	- = signs and missing numbers Continue using a range of equations as in Year 1 and 2 but with appropriate numbers. The Empty Number Line for finding difference by counting back: counting back in tens and ones e.g. $84 - 56 =$   Counting up $84 - 56 = 28$ Column method:  If children are unable to understand column method do the method below first, to explain place value. Partitioning: Use known number facts and place value to subtract (partition number to be subtracted only) $77 - 12 = 77 - 10 - 2$ $= 67 - 2$ $= 65$



Use the vocabulary related to addition and subtraction and symbols to describe and record addition and subtraction number sentences.

Recording by:

- drawing jumps on number lines
- drawing jumps on blank number lines

This method should be introduced in the **Spring Term** of Year 2:

Compact decomposition (For numbers which are not carried over)

$$\begin{array}{r} 32 \\ - 11 \\ \hline 21 \end{array}$$

Column method: (For numbers which do involve carrying over)

$$\begin{array}{r} \overset{2}{\cancel{3}} \overset{1}{\cancel{2}} \\ - 19 \\ \hline 13 \end{array}$$

If children are unable to understand column method do the method below first, to explain place value.

Expanded decomposition

Move to decomposition that does not involve exchanging ; $32 - 11$

3	0		2
1	0		1
2	0		1

$$20 + 1 = 21$$

Expanded decomposition

Move to decomposition that does not involve exchanging

	8	0		5
	6	0		4
	2	0		1

WRITTEN METHODS FOR SUBTRACTION ~ PROGRESSION FROM Y4 - Y6

Year Four

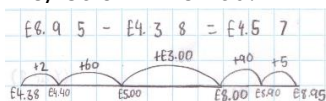
Subtract up to 4 digits HOU - TO/ HTO - HTO/ ThHTO - HTO/ ThHTO - ThHTO and £.p

5

Column method:

$$\begin{array}{r} 2854 \\ - 1562 \\ \hline 1192 \end{array}$$

Extend to numbers with at least four digits and decimals in the context of money £.p using number line/ column method.



$$\begin{array}{r} 8.95 \\ - 4.38 \\ \hline 4.57 \end{array}$$

Partitioning: Use known number facts and place value to subtract (partition number to be subtracted only)

$$\begin{aligned} 277 - 192 \\ = 277 - 100 - 90 - 2 \\ = 177 - 90 - 2 \\ = 87 - 2 \\ = 85 \end{aligned}$$

(If children are unable to understand column method do this first to explain place value.)

Expanded decomposition

$$\begin{array}{r} 2754 - 1562 = 1192 \\ \hline \end{array}$$

Year Five

Subtract up to 5 digits including using formal written methods and decimals with up to two places.

Compact decomposition

$$\begin{array}{r} 28128 \\ - 2128 \\ \hline 28928 \end{array}$$

Compact decomposition (decimals)

$$\begin{array}{r} 7169.0 \\ - 372.5 \\ \hline 6796.5 \end{array}$$

Subtract numbers with up to 5 digits:

*Revert back to expanded column subtraction if needed.

Year Six

Subtract with increasingly large and more complex numbers and decimal values.

Compact decomposition

$$\begin{array}{r} 89949 \\ - 89949 \\ \hline 60750 \end{array}$$

Compact decomposition (decimals)

$$\begin{array}{r} 105.41 \\ - 36.08 \\ \hline 69.33 \end{array}$$

* Revert back to expanded column subtraction if needed.

Written methods for multiplication of whole numbers

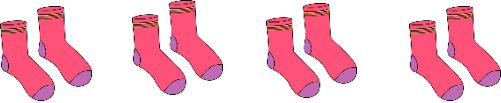
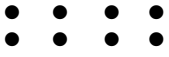
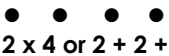
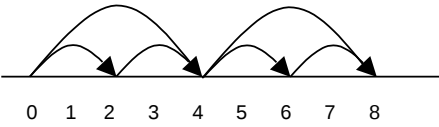
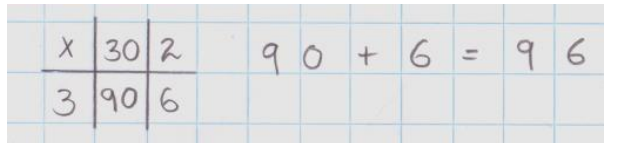
The aim is that children use mental methods when appropriate, but for calculations that they **cannot** do in their heads they use an efficient written method accurately and with confidence. Children are entitled to be taught and to acquire secure mental methods of calculation and one efficient written method of calculation for multiplication which they know they can rely on when mental methods are not appropriate.

To multiply successfully, children need to be able to:

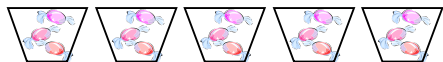
- recall all multiplication facts to 10×10 ;
- partition number into multiples of one hundred, ten and one;
- work out products such as 70×5 , 70×50 , 700×5 or 700×50 using the related fact 7×5 and their knowledge of place value;
- add two or more single-digit numbers mentally;
- add multiples of 10 (such as $60 + 70$) or of 100 (such as $600 + 700$) using the related addition fact, $6 + 7$, and their knowledge of place value;
- add combinations of whole numbers using the column method.

Note: *It is important that children's mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for multiplication.*

WRITTEN METHODS FOR MULTIPLICATION ~ PROGRESSION FROM Y1 – Y3

<u>Year One</u> Multiply with concrete objects, arrays and pictorial representations.	<u>Year Two</u> (using 2, 5 and 10 times table facts)	<u>Year Three</u> (10 x 0)
<u>Multiplication is related to doubling and counting groups of the same size.</u>   Looking at columns $2 + 2 + 2$ 3 groups of 2 Looking at rows $3 + 3$ 2 groups of 3 <u>Counting using a variety of practical resources</u> 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. all fingers, toes...  <u>Pictures / marks</u>	<u>x = signs and missing numbers</u> $7 \times 2 = \square$ $\square = 2 \times 7$ $7 \times \square = 14$ $14 = \square \times 7$ $\square \times 2 = 14$ $14 = 2 \times \square$ $\square \times \nabla = 14$ $14 = \square \times \nabla$ <u>Arrays and repeated addition</u>  $4 \times 2 \text{ or } 4 + 4$  $2 \times 4 \text{ or } 2 + 2 + 2 + 2$ <u>Grouping on number line:</u>  <u>Partitioning and grid method</u> Children need to be secure with partitioning numbers into 10s and 1s and partitioning in different ways: $6 = 5 + 1$ so double 6 is the same as double five add double one.  AND double 15 $10 + 5$ $20 + 10 = 30$ OR	<u>x = signs and missing numbers</u> Continue using a range of equations as in Year 2 but with appropriate numbers. <u>Arrays and repeated addition</u> Continue to understand multiplication as repeated addition and continue to use arrays (as in Year 2). <u>Grouping on number line:</u> Continue to understand multiplication as repeated addition on a number line (as in Year 2). <u>Partitioning and grid method</u>  Use known facts and place value to carry out simple multiplications Use the same method as above (partitioning), e.g. $3 \times 3 = 9$, therefore $30 \times 3 = 90$ $32 \times 3 = 96$ 

There are 3 sweets in one bag.
How many sweets are there in 5 bags?



x	1	0		5	
2	2	0	1	0	

$$20 + 10 = 30$$

WRITTEN METHODS FOR MULTIPLICATION ~ PROGRESSION FROM Y4 - Y6

Year Four (TO x O/ HTO X O)

x = signs and missing numbers

Continue using a range of equations with appropriate sized numbers

Expanded short multiplication (multiplication by a single digit)

Children should describe what they do by referring to the actual values of the digits in the columns. For example, the second step in 38×7 is 'thirty multiplied by seven', not 'three times seven', although the relationship 3×7 should be stressed.

$$\begin{array}{r} 38 \\ \times 7 \\ \hline 266 \end{array}$$

Column method for short multiplication

The recording is reduced further, with carry digits recorded above the multiplication.

$$\begin{array}{r} 38 \\ \times 7 \\ \hline 266 \end{array}$$

Partitioning and grid method

Estimate an answer first:

23×7 is approximately $20 \times 10 = 200$

$$\begin{array}{r} 20 \\ \times 7 \\ \hline 140 \end{array} \quad \begin{array}{r} 3 \\ \times 21 \\ \hline 63 \end{array}$$

$$140 + 21 = 161$$

Year Five (TO x O/ TO x TO/ HTO x O/ HTO x TO/ ThHTO x O/ ThHTO x TO)

x = signs and missing numbers

Continue using a range of equations with appropriate sized numbers

Expanded short multiplication: (See year 4 example)

Column Method for short multiplication

$$\begin{array}{r} 346 \\ \times 9 \\ \hline 3114 \end{array}$$

Expanded long multiplication (multiplication by 2 or more digits)

$$\begin{array}{r} 56 \\ \times 27 \\ \hline 1000 \quad (50 \times 20) \\ 120 \quad (6 \times 20) \\ 350 \quad (50 \times 7) \\ 42 \quad (6 \times 7) \\ \hline 1512 \end{array}$$

Move on to long multiplication when secure

$$\begin{array}{r} 56 \\ \times 27 \\ \hline 392 \\ 1120 \\ \hline 1512 \end{array}$$

Long multiplication should be introduced latest by summer term.

Year Six (Multiply numbers with at least 4-digits by a 2-digit numbers and 1 and 2 digit whole numbers with numbers with up to 2 decimals places)

x = signs and missing numbers

Continue using a range of equations with appropriate sized numbers

Partitioning and grid method

Estimate an answer first:

372×24 is approximately $400 \times 20 = 8000$

Extend to decimals with up to two decimal places.

Expanded short multiplication (See year 4 example)

Extend to decimals with up to 2dp

$$\begin{array}{r} 4.9 \times 3 = 14.7 \\ 4.9 \times 4.9 = 24.01 \\ \times 33 \\ + 2.7 \quad (0.9 \times 3) \\ + 12.0 \quad (4 \times 3) \\ \hline 14.7 \end{array}$$

Short multiplication

$$\begin{array}{r} 4346 \\ \times 8 \\ \hline 34768 \end{array} \quad \begin{array}{r} 4.9 \\ \times 3 \\ \hline 14.7 \end{array}$$

(with decimal multiplication, move decimal down to answer column)

Expanded long multiplication (see year 5 example)

Children who are already secure with column multiplication for $TO \times O$ and $TO \times TO$ should have little difficulty in using the same method for $HTO \times TO$ or applying decimals.

Long multiplication

$$\begin{array}{r} 586 \\ \times 37 \\ \hline 4102 \\ 17580 \\ \hline 21682 \end{array}$$

(with decimal multiplication, move decimal down to answer column)

Written methods for division of whole numbers

The aim is that children use mental methods when appropriate, but for calculations that they **cannot** do in their heads they use an efficient written method accurately and with confidence. Children are entitled to be taught and to acquire secure mental methods of calculation and one efficient written method of calculation for division which they know they can rely on when mental methods are not appropriate.

To divide successfully in their heads, children need to be able to:

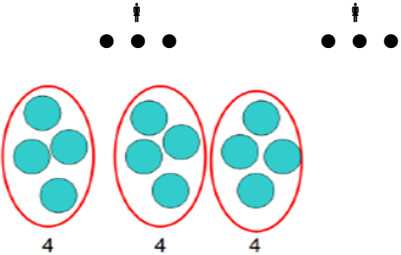
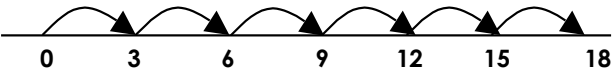
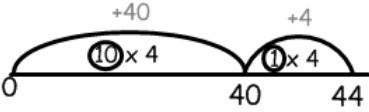
- understand and use the vocabulary of division – for example in $18 \div 3 = 6$, the 18 is the dividend, the 3 is the divisor and the 6 is the quotient;
- partition two-digit and three-digit numbers into multiples of 100, 10 and 1 in different ways;
- recall multiplication and division facts to 10×10 , recognise multiples of one-digit numbers and divide multiples of 10 or 100 by a single-digit number using their knowledge of division facts and place value;
- know how to find a remainder working mentally – for example, find the remainder when 48 is divided by 5;
- understand and use multiplication and division as inverse operations.

Note: *It is important that children's mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for division.*

To carry out written methods of division successfully, children also need to be able to:

- understand division as repeated subtraction;
- estimate how many times one number divides into another – for example, how many sixes there are in 47, or how many 23s there are in 92;
- multiply a two-digit number by a single-digit number mentally;
- subtract numbers using the column method.

WRITTEN METHODS FOR DIVISION ~ PROGRESSION FROM Y1 – Y3

<u>Year One</u>	<u>Year Two</u> (using 2, 5 and 10 times table facts)	<u>Year Three</u> (TO ÷ O)
<u>Sharing</u> Requires secure counting skills. Use practical activities that involve sharing, distributing cards when playing a game, putting objects onto plates, into cups, hoops etc. 6 sweets are shared between 2 people. How many do they have each?  12 shared between 3 is 4 <u>Grouping</u> Sorting objects into 2s / 3s/ 4s etc How many pairs of socks are there?  How many groups of 4 can be made with 12 stars? = 3  There are 12 crocus bulbs. Plant 3 in each pot. How many pots are there?	<u>÷ = signs and missing numbers</u> $6 \div 2 = \square \quad \square = 6 \div 2$ $6 \div \square = 3 \quad 3 = 6 \div \square$ $\square \div 2 = 3 \quad 3 = \square \div 2$ $\square \div \nabla = 3 \quad 3 = \square \div \nabla$ <u>Grouping and sharing</u> Practical grouping and sharing as Year 1 but with larger numbers. 20 cupcakes are shared between 5 children. How many cupcakes do they each get?  Count up to 100 objects by grouping them and counting in tens, fives or twos;	<u>÷ = signs and missing numbers</u> Continue using a range of equations as in Year 2 but with appropriate numbers. <u>Understand division as sharing and grouping</u> 18 ÷ 3 can be modelled as: Sharing – 18 shared between 3 OR Grouping - How many 3's make 18?  <u>Grouping using a number line- forward jumps in multiples of the divisor:</u> 44 ÷ 4 = 11  10 + 1 = 11

Jo has 12 Lego wheels. How many cars can she make?

Sharing: There are 12 strawberries. They are shared between 4 people. How many do they have each?



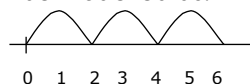
Find one half, one quarter and three quarters of shapes and sets of objects.

Grouping: How many 2s make 6?

In PE, 30 children get into teams of 5 to play a game. How many teams are there?

Grouping using a number line

$6 \div 2$ can be modelled as:



In the context of money count forwards and backwards using 2p, 5p and 10p coins

Half and double:

$$\frac{1}{2} \text{ of } 90 \\ = 90 \div 2 = 45$$

$$\frac{1}{4} \text{ of } 36 \\ = 36 \div 4 = 9 \\ \text{or } 36 \div 2 = 18, 18 \div 2 = 9$$

$$\text{double } 45 = 45 \times 2 = 90$$

(This method should be introduced latest by the Spring Term)

Chunking method:

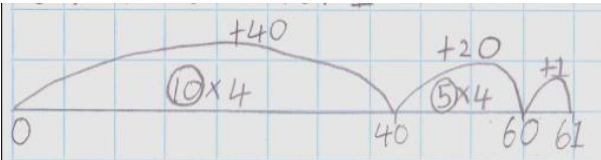
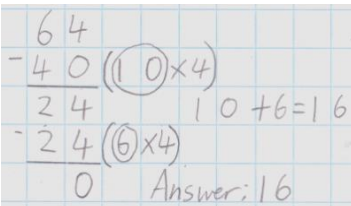
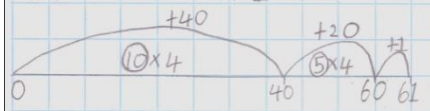
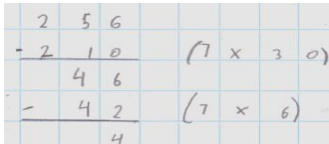
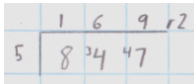
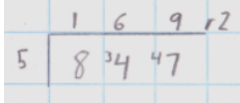
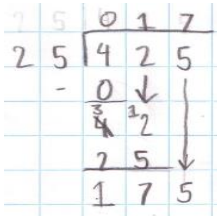
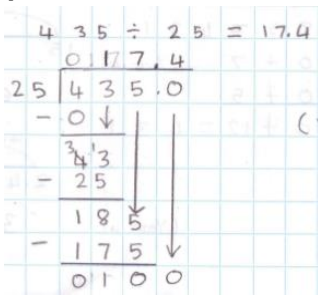
$$64 \div 4 =$$

And with remainders:

$$96 \div 7 \\ \begin{array}{r} 96 \\ - 70 \quad (10 \times 7) \\ \hline 26 \\ - 21 \quad (3 \times 7) \\ \hline 5 \end{array} \quad \text{Answer: } 13 \text{ r. } 5$$

(This method should be introduced latest by the Summer Term)

WRITTEN METHODS FOR DIVISION ~ PROGRESSION FROM Y4 - Y6

Year Four (TO ÷ O/ HTO ÷ O)	Year Five (TO ÷ O/ TO ÷ TO/ HTO ÷ O/ HTO ÷ TO/ ThHTO ÷ O/ ThHTO ÷ TO)	Year Six (Divide numbers with at least 4-digits by a 2-digit whole number and decimals)										
<u>÷ = signs and missing numbers</u> Continue using a range of equations as in Year 2 but with appropriate numbers. <u>Grouping using a number line- forward jumps in multiples of the divisor: (including remainders)</u> 61 ÷ 4 =  10 + 5 = 15 r1 61 ÷ 4 = 15 r1 <u>Chunking method:</u> 64 ÷ 4 =  And with remainders: 96 ÷ 7 <table><tr><td>96</td><td></td></tr><tr><td>- 70</td><td>(10 x 7)</td></tr><tr><td>26</td><td></td></tr><tr><td>- 21</td><td>(3 x 7)</td></tr><tr><td>5</td><td></td></tr></table> Answer: 13 r. 5 Extend to division of 3 digits by 1 digit	96		- 70	(10 x 7)	26		- 21	(3 x 7)	5		<u>Grouping using a number line- forward jumps in multiples of the divisor: (including remainders)</u>  Quotients to be expressed as fractions or decimal fractions 61 ÷ 4 = 15r 1 = 15 ¼ or 15.25 <u>Chunking method</u> 256 ÷ 7 = Estimate first: 256 ÷ 7 lies between 210 ÷ 7 = 30 and 280 ÷ 7 = 40 * Partition the dividend (256) into multiples of the divisor (7): e.g. 256 = 210 + 46  30 + 6 = 36 r4 256 ÷ 7 = 36 r4 <u>Short Division (when the divisor is a single digit)</u> quotient divisor 5 $\overline{)847}$ dividend Considering each column starting from the left. Write down how many times your divisor goes into the first number of the dividend (8). If there is a remainder, that's okay. Write down your remainder to the left of the next digit in the dividend. Continue. Repeat steps 1-3 until you are done: 	<u>Short Division Method</u>  <u>Long division</u> 425 ÷ 25 =  (Move on to remainders and decimals) 
96												
- 70	(10 x 7)											
26												
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5												

Appendix 1

Reordering

Sometimes a calculation can be more easily worked out by changing the order of the numbers. The way in which children rearrange numbers in a particular calculation will depend on which number facts they have instantly available to them.

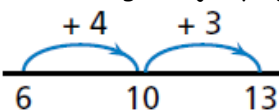
It is important for children to know when numbers can be reordered (eg $2 + 5 + 8 = 8 + 2 + 5$ or $15 + 8 - 5 = 15 - 5 + 8$ or $23 - 9 - 3 = 23 - 3 - 9$) and when they cannot (eg $8 - 5 \neq 5 - 8$).

The strategy of changing the order of numbers only really applies when the question is written down. It is difficult to reorder numbers if the question is presented orally.

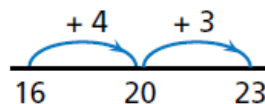
Appendix 2

Partitioning – Bridging through multiples of 10

An important aspect of having an appreciation of number is to know when a number is close to 10 or a multiple of 10: to recognise, for example, that 47 is 3 away from 50, or that 96 is 4 away from 100. When adding or subtracting mentally, it is often useful to make use of the fact that one of the numbers is close to 10 or a multiple of 10 by partitioning another number to provide the difference. The use of an empty number line where the multiples of 10 are seen as 'landmarks' is helpful and enables children to have an image of jumping forwards or backwards to these 'landmarks'. For example:

$$6 + 7 = 6 + 4 + 3$$


In the case of subtraction, bridging through the next 10 or multiple of 10 is a very useful method (often termed 'shopkeeper's subtraction'; it is the method used almost universally with money). So the change from £1 for a purchase of 37p is carried out thus: '37 and 3 is 40 and 10 is 50 and 50 is £1'. The use of actual coins, or the image of coins, helps to keep track of the subtraction. The empty number line can provide an image for this method when the subtraction does not involve money. The calculation $23 - 16$ can be built up as an addition:



Appendix 3

Partitioning - Using multiples of 10 and 100

It is important for children to know that numbers can be partitioned into, for example, hundreds, tens and ones, so that $326 = 300 + 20 + 6$. In this way, numbers are seen as wholes, rather than as a collection of single-digits in columns. This way of partitioning numbers can be a useful strategy for addition and subtraction. Both numbers involved can be partitioned in this way, although it is often helpful to keep the first number as it is and to partition just the second number:

$$30 + 47 = 30 + 40 + 7$$

$$\begin{aligned} 25 + 14 &= 20 + 5 + 10 + 4 \\ &= 20 + 10 + 5 + 4 \end{aligned}$$

$$\begin{aligned} 68 - 32 &= 60 + 8 - 30 - 2 \\ &= 60 - 30 + 8 - 2 \end{aligned}$$

Appendix 4

Partitioning - Compensating

This strategy is useful for adding numbers that are close to a multiple of 10, for adding numbers that end in 1 or 2, or 8 or 9. The number to be added is rounded to a multiple of 10 plus a small number or a multiple of 10 minus a small number. For example, adding 9 is carried out by adding 10 and then subtracting 1 ($34 + 9 = 34 + 10 - 1$), and subtracting 18 is carried out by subtracting 20 and adding 2 ($84 - 18 = 84 - 20 + 2$). A similar strategy works for decimals, where numbers are close to whole numbers or a whole number of tenths. For example, $1.4 + 2.9 = 1.4 + 3 - 0.1$ or $2.45 - 1.9 = 2.45 - 2 + 0.1$.