

Earlsmead Primary School

Calculation Policy - Mental Methods

Policy summary Mathematics Calculation Policy - Mental Methods

Affects For parents and children

Drafted by Adell Horbury

Approved by Headteacher

Last approved revision date October 2020

Review date October 2022

Related policies, procedures and forms Mathematics Calculation Policy - Written Methods

Calculation Policy – Mental Methods

This policy contains the mental methods that are to be taught throughout the school. It has been written to ensure consistency and progression throughout the school. It is important to recognise that the ability to calculate mentally lies at the heart of numeracy. Children's mental methods of calculation must be practiced on a regular basis and secured alongside their learning.

The ability to calculate in your head is an important part of mathematics. It is also an essential part of coping with society's demands and managing everyday events. The overall aim of this policy is that when children leave our school, they have a secure knowledge of number facts and are able to solve problems mentally, selecting an efficient strategy from a range of known approaches. Research by the Department for Education demonstrates that the development of quick recall, accuracy and fluency in parallel with the development of understanding and reasoning are all required to promote sound mathematical development (DfE 2012 p70). Procedural fluency and conceptual understanding are not mutually exclusive. The Ofsted Survey of Good Practice in Primary Mathematics (Ofsted 2011) found that many of the successful schools sampled teach fluency in mental and written methods of calculation, alongside understanding of the underlying mathematical concepts.

The following pages include a mental calculations policy adapted following the New National Curriculum. Arithmetical proficiency is a key component of the 2014 National Curriculum.

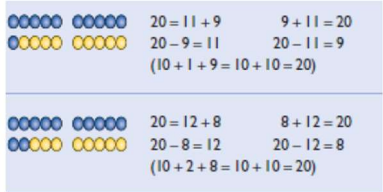
THIS POLICY SHOULD BE READ IN CONJUNCTION WITH THE SCHOOL'S MATHEMATICS WRITTEN CALCULATION POLICY.

Aims

- To ensure a consistent and progressive approach exists within the school to secure good to outstanding progress in mental calculation.
- To ensure that mental calculation is an integral part of numeracy lessons.
- Children make use of diagrams and informal notes (jottings) to help record steps when using mental methods that generate more information than can be kept in their heads to support/extend the development of more fluent and sophisticated mental strategies.
- Although mental calculation skills 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. In addition, if children are secure in certain forms of mental calculation, differentiation should provide children the opportunity to progress to a more sophisticated form.
- For children to reflect upon which method to use to solve a problem and ask questions such as 'Do I need to use a written method or can I do this in my head?', 'Is my answer sensible?'

- For children to be able to clearly explain the mental calculation and justify why their answer are correct using sound mathematical vocabulary. Therefore strong speaking and listening opportunities underpin good mathematics teaching using the correct mathematical vocabulary.
- To share progress mental calculation with parents so that they have the confidence and knowledge to support their children at home with their mathematical development.
- For children to use their mental skills to check the steps involved in a written calculation and decide if their answer makes sense.

Year 1: End of Year Mental Calculations Expectations

Rapid Recall and Counting	Children should be able to use the following Mental Strategies , as appropriate for mental calculations	Children should be able to Calculate Mentally
<ul style="list-style-type: none"> ● Count from 1 and from any other number forwards and backwards in 1's 2's 5's 10's ● Distinguish between ordinal (a <i>number</i> that tells the position of something in a list. 1st, 2nd, 3rd, 4th, 5th etc.) and cardinal numbers (numbers that say how many of something there are, such as one, two, three, four, five) ● Know by heart all number bonds to 20 in 3 forms...$6 + 8 = 14$, $14 - 8 = 6$, $14 - 6 = 8$ ● Recall doubles of all numbers to at least twenty and corresponding halves ● Begin to recognise two-digit multiples of 2, 5, 10 ● Know odd and even numbers 	<ul style="list-style-type: none"> ● Re-order numbers in a calculation e.g. $2 + 5$ to $5 + 2$ noticing that this does not change the answer ● Begin to bridge through 10, and later 20, when adding a single digit number ● Use known number facts and place value to add or subtract pairs of single-digit numbers <div data-bbox="806 438 1187 630" style="text-align: center; border: 1px solid black; padding: 5px; margin: 10px 0;">  </div> <ul style="list-style-type: none"> ● Add 9 to single-digit numbers by adding 10 and then subtracting 1 ● Identifying near doubles, using doubles already known i.e. $8 + 7$ is $7 + 7 + 1$, or $8 + 8 - 1$ ● Use patterns of similar calculations i.e. $9 + 1 = 10$, $9 + 2 = 11$, $9 + 3 = 12$ ● Begin to partition to add numbers close to a multiple of 10 e.g. $5 + 9 = 5 + 10 - 1$ (using a number line) ● Bridging through numbers other than 10, e.g. 1 week = 7 days 'It is half past seven. What time was it 3 hours ago?' 	<ul style="list-style-type: none"> ● Add or subtract a single digit to or from a single digit without crossing 10 i.e. $4 + 5$, $8 - 3$ ● 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. $13 + 5$, $17 - 3$ ● Doubles of all numbers to 20, e.g. $7 + 7$, double 9 ● Add or subtract 10 to any 2 digit number i.e. $32 + 10 = 42$, recognising patterns and the digit that changes.

Year 2: End of Year Mental Calculations Expectations

Rapid Recall and Counting	Children should be able to use the following Mental Strategies , as appropriate for mental calculations	Children should be able to Calculate Mentally
<ul style="list-style-type: none"> ● Count in steps of 2, 3, 5 and 10 from any given number ● Count in fractions up to 10, using $\frac{1}{2}$ and $\frac{2}{4}$ equivalence ● Know by heart all number bonds that total 20 ● Know by heart all addition and subtraction facts for each number up to 20 ● Know by heart doubles of all number to 20 ● Know by heart all halves of numbers to 20 ● Know by heart all multiplication facts for 2, 5 and 10 tables ● Know division facts for multiples of 2, 5, 10 ● Know by heart all bonds of multiples of 10 up to 100 e.g. $30 + 70$ 	<ul style="list-style-type: none"> ● Find 10 more and less than numbers to 100 ● Find a difference by calculating from the smaller to the larger number. ● Reorder numbers in a calculation, e.g. $2 + 36 = 36 + 2$, $5 + 7 + 5 = 5 + 5 + 7$ ● Add three small numbers by putting the largest number first and/or finding a pair totalling 10. i.e. $2 + 6 + 9$ becomes $9 + 6 + 2$ and $8 + 3 + 2$ becomes $(8 + 2) + 3 = 13$ ● Respond to questions such as 'Tell me three numbers that add to 20?' ● Work out $1 + \square + 5 = 17$ ● Bridging through numbers other than 10, e.g. 1 year = 12 months. 10.30 to 10.45 ● Partition additions into 10s and units and then recombine mentally with 2 digit numbers that total less than 100 i.e. $24 + 12 = 20 + 10 + 4 + 2 = 30 + 6 = 36$ ● Partitioning bridging through multiples of 10: $6 + 7 = 6 + 4 + 3$ and $23 - 9 = 23 - 3 - 6$ ● Use known number facts and place value to add or subtract pairs of numbers ● Understanding place value to multiply and divide by 10, moving digits to right to multiply by 10 and to the left to divide by 10, i.e. $17 \times 10 = 170$, $30 \div 10 = 3$. ● Add or subtract 9, 19, 11 or 21 by rounding and compensating, i.e. $37 + 9 = 37 + 10 - 1 = 46$ ● Using near doubles e.g. $13 + 14$ is double 14 and subtract 1 or double 13 and add 1. ● Understanding halving as the inverse of doubling ● Use the relationship between addition and subtraction i.e. $8 + 7 = 15$ therefore $15 - 8 = 7$ and $15 - 7 = 8$ ● Use knowledge of number facts and place value to multiply and divide by 2, 5, and 10 ● Uses patterns of similar calculations, e.g. $12 + 7 = 19$, $120 + 70 = 190$ 	<ul style="list-style-type: none"> ● Add or subtract a single-digit to or from any two-digit without crossing the tens boundary e.g. $62 + 4$, $38 - 7$ ● Add or subtract a single-digit to or from 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. $24 + 14$, $48 - 13$ ● Find what must be added to any two-digit multiple of 10 to make 100, e.g. $70 + \square = 100$ ● Add or subtract a multiple of 10 to or 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. Double any multiple of 5 up to at least 50, e.g. double 35. ● Halve any multiple of 10 up to 100 e.g. halve 50 ● Mental addition and subtraction of two two-digit numbers, totalling less than 100


Year 3: End of Year Mental Calculations Expectations

Rapid Recall and Counting	Children should be able to use the following Mental Strategies , as appropriate for mental calculations	Children should be able to Calculate Mentally
<ul style="list-style-type: none"> ● Order numbers and compare to 1000 ● Count in multiples of 2, 3, 4, 5, 8 and 10 forwards and backwards ● Count in 50's and 100's ● Know 10 or 100 more than numbers to 1000 ● Count in fractions to 10; also count forwards and backwards in tenths. Recognise equivalents ● Know by heart addition and subtraction facts for each number up to 20 ● Know by heart all sums and differences of multiples of 10 up to 100 ● Know by heart all doubles of multiples of 5 and 10 up to 100 ● Know by heart all halves of multiples of 10 up to 100 ● Know by heart all multiplication facts for 2, 3, 4, 5, 8, 10 up to 12 ● Know the corresponding division facts for above tables to 12 ● Recognise multiples of 2, 5, 10 up to 1000 ● Know all pairs of multiples of 100 with a total of 1000 e.g. 800 + 200 ● Know all pairs of multiples of 5 with a total of 100 i.e. 56 + 35 	<ul style="list-style-type: none"> ● Find a difference by calculating from the smaller to the larger number, e.g. $82 - 47 = 15$ ● Reorder numbers in a calculation e.g. $12 - 7 = 12 - 2 - 5$ ● Add three or four small numbers by putting the largest number first and/or finding pairs totalling 10 ● Partition into tens and units and recombine, for calculating, answers to exceed 100 ● Bridge through a multiple of ten and adjust be able to do this with 3 digit numbers, e.g. $149 + 32 = 149 + 1 + 31$, $150 + 31 = 81$ ● Add and subtract pairs of 1 and 2 digit numbers ● Add and subtract 3 digit numbers and 1 digit, 3 digit and tens, 3 digit and hundreds ● Recognise fractions and pairs of fractions equivalent to one ● Calculate with fractions that have same denominator within one whole e.g. $1/7 + 2/7 = 3/7$ ● Recognise and use inverses with + and -, multiplication and division ● Partition into '5 and a bit' when adding 6, 7, 8 or 9, then recombine. i.e. $27 + 8 = 27 + 3 + 5 = 35$ ● Add or subtract mentally a 'near multiple of 10' to or from a two digit numbers e.g. $53 + 71 = 58 + 70 + 1$ ● Identify near doubles e.g. $18 + 16$ is double 18 and subtract 2 or double 16 and add 2. Understand doubling as inverse of halving ● Use patterns of similar calculations, $15 + 17 = 32$ therefore $150 + 170 = 320$ ● Say or write a subtraction statement corresponding to a given addition statement, e.g. $16 + 13 = 29$, $29 - 13 = 16$ etc. ● 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, 3, 4, 5, 10 and 100 ● Say or write a division statement corresponding to a given multiplication statement 	<ul style="list-style-type: none"> ● Find what must be added to any multiple of 100 to make 1000 e.g. $300 + \square = 1000$ ● Add or subtract any pair of two-digit numbers, with and without crossing a tens boundary or 100 e.g. $33 + 45$, $87 - 12$ ● Find what must be added to / subtracted from any two-digit number to make the next higher / lower multiple of 10, e.g. $64 + \square = 76$, $56 - \square = 50$ ● Subtract any 3 digit number from any three-digit number when the difference is less than 10 e.g. $458 - 451$ ● Find what must be added to /subtracted from any three digit number to make the next higher/lower multiple of 10, e.g. $647 + \square = 650$ ● Double any number to at least 20 e.g. double 18 and corresponding halves, $1/2$ of 36 ● Multiply single digit numbers by 10 or 100 e.g. 6×100 ● Divide any multiple of 10 x 10 e.g. $60 \div 10$

Year 4: End of Year Mental Calculations Expectations

Rapid Recall and Counting	Children should be able to use the following Mental Strategies , as appropriate for mental calculations	Children should be able to Calculate Mentally
<ul style="list-style-type: none"> ● Count in multiples of 2, 3, 4, 5, 6, 7, 8, 9, 10, 25, 100, 1000 from any number ● Say 10, 100, 1000 more or less than a number ● Count up through the next multiple of 10, 100 or 1000 e.g. 789, 799, 809, etc. ● Reorder numbers in a calculation ● Count in fractions and decimal fractions forwards and backwards ● Double any two or three digit number ● Halve any 2 or 3 digit number ● Know all multiplication tables to 12 x 12 ● Know division tables up to multiple 12 x 12 ● Know decimal equivalents to $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and any number of tenths and hundredths 	<ul style="list-style-type: none"> ● Round any number to nearest 10 or 100 ● Use place value to aide calculation ● Show use of number facts in mental calculation strategies and be able to talk about them ● Calculate with increasingly complex numbers e.g. $12,462 - 2,400$ or $12,462 + 600$ ● Bridge through a 100 or 1000 $89 + 67$ ($67 = 11 + 56$) $\Rightarrow 89 + 11 + 56 = 156$ ● Add or subtract 9, 19, 29, 11, 21, etc. by rounding and compensating ● Use knowledge of near doubles ● Continue to use the relationship between addition and subtraction, multiplication and division ● Use knowledge of multiplication and division facts to calculate questions such as 640 divided by 8, ● Double two and three digit numbers ● Partition to carry out multiplication $56 \times 7 = (50 \times 7) + (6 \times 7) = 350 + 42 = 392$ ● Use closely related facts to carry out multiplication and division, e.g. $7 \times 6 = 42$ therefore $70 \times 6 = 420$ 	<ul style="list-style-type: none"> ● Find what must be added to any two digit number to make 100 e.g. $37 + ? =$ ● 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. $3641 - 3628$ or $6002 - 5991$ ● 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 to 500 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 e.g. 26×10 ● Divide a multiple of 100 by 10 e.g. $600 \div 10$ ● Multiply any two-digit multiple of 10 by 2, 3, 4, 5 e.g. 60×4, 80×3

Year 5: End of Year Mental Calculations Expectations

Rapid Recall and Counting	Children should be able to use the following Mental Strategies , as appropriate for mental calculations	Children should be able to Calculate Mentally
<ul style="list-style-type: none"> ● Count forwards and backwards in steps of 10, 100, 1000 or 10,000 for any given number up to 1,000,000 ● Round numbers up to 1,000,000 to nearest 10,100,1000,10,000 and 100,000 ● Count in decimal fractions and decimals understanding the place value of each digit ● Count in fractions and recognise equivalents ● Reorder numbers in a calculation ● Double any number with up to 2 decimal places ● Halve any number with up to 2 decimal places ● Recall quickly multiplication and division facts up to 12x12 and use them to multiply and divide pairs of multiples of 10 and 100, e.g. 30×70, $240 \div 40 = 60$ ● Identify pairs of factors for 2 digit whole numbers, e.g. <div style="text-align: center; margin: 10px 0;">  </div> <ul style="list-style-type: none"> ● Recall prime numbers to 19 ● Know connections between percentages, fractions and decimals 	<ul style="list-style-type: none"> ● Use estimation in calculating and verbalise ● Calculate whether a number up to 100 is prime ● Add and subtract, multiply and divide mentally with increasingly large numbers, practicing speed and fluency ● Use partitioning and place value in calculation ● Add or subtract the nearest multiple of 10, 100 or 1000 then adjust ● Use doubling and halving ● Identify near doubles and use in strategies to calculate ● Use factors, e.g. $15 \times 6 = 15 \times 3 = 45$ $45 \times 2 = 90$ ● Work out sixths by halving thirds etc. ● Use closely related facts to carry out multiplication and division $11 \times 15 = (8 \times 15) + (2 \times 15) + (1 \times 15)$ $(8 = 2 \times 2 \times 2)$ therefore $15 \times 2 \times 2 \times 2 = 120$ $120 + 30 + 15 = 165$ ● Use the relationship between addition and subtraction, multiplication and division 	<ul style="list-style-type: none"> ● Add or subtract any pair of three-digit numbers e.g. $560 + 250$, $620 - 380$ ● 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 or 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. $5001 - 1997$ ● Multiply any two or three-digit number by 10 or 100, e.g. 26×10, 79×100 ● Divide a multiple of 100 by 10 by a single-digit e.g. 60×7 ● Find 50%, 25% 10% of a small whole number or quantities e.g. 25% of £8 ● Calculate complements of 1 with two decimal numbers to two places

Year 6: End of Year Mental Calculations Expectations

Children should be able to Rapidly recall	Children should be able to use the following Mental Strategies , as appropriate for mental calculations	Children should be able to Calculate Mentally
<ul style="list-style-type: none"> ● Be able to order to 10 million ● Continue to count regularly, whole numbers, fractions, decimals, negative numbers ● Introduce counting in binary numbers ● Generate linear number sequences including negative and decimal numbers e.g. 1.4, 1.1, 0.8 ● Know by heart all the squares and square roots of numbers between 12 x 12 ● Recognise and recall factors of numbers up to 100 and corresponding multiples of 100 ● Use knowledge of place value and number facts to derive related \times / \div facts, e.g. $0.8 \times 7 = 5.6$ ● Know by heart test of divisibility for multiples of 2, 3, 4, 5, 6, 9, 10 and 12 	<ul style="list-style-type: none"> ● Consolidate all strategies from previous years ● Use known number facts and place value to add or subtract pairs of three digit multiples of 10 and two digit numbers with two decimal places ● Add or subtract the nearest multiple of 10 or 100, 1000, 10,000, then adjust ● Continue to use the relationship between addition and subtraction, multiplication and division ● Use factors e.g. $35 \times 18 = 35 \times 2 \times 3 \times 3$ ● Use knowledge of place value and number bonds to aide calculation ● Use doubling and halving ● Use closely related facts to carry out multiplication and division. ● Work out 17 times table by adding 7 and 10 times facts and other multiplication tables ● Use the relationship between multiplication and division e.g. $0.75 \times 4 = 3$ buy one get three free ● Calculate with unit fractions and use the knowledge of this to see inverse. $\frac{1}{4}$ of a length is 36 so the total length is $36 \times 4 = 144$ ● Use knowledge of fractions and decimals to calculate remainders 	<ul style="list-style-type: none"> ● Practice mental calculations and ensure an increased speed of complex calculations ● Perform mental calculations with mixed operations ● Multiply any two-digit number by a single-digit e.g. 34×6 ● Multiply any two-digit number by 50 (multiply by 100 and halve answer) e.g. 23×50 or by 25 (multiply by 100 and divide by 4) e.g. 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, of 5 kg of 2 metres