

Bury C of E Primary School

Mathematics Calculations Progression Document

YEAR 6

At Bury CE Primary, we believe that children should be introduced to the processes of calculation through practical, oral and mental activities. As children begin to understand the underlying ideas, they develop ways of recording to support their thinking and calculation methods; use particular methods that apply to special cases and learn to interpret and use the signs and symbols involved.

Choosing the appropriate strategy, recording in mathematics and in calculation in particular is an important tool both for furthering the understanding of ideas and for communicating those ideas to others. Children use age appropriate calculations in order to become **fluent** in that strategy, they will then use calculation strategies to support their thinking and **reasoning**, making connections in their mathematical understanding and for them to become efficient at **problem solving**.

Written methods are complementary to mental methods and should not be seen as separate from them. The aim is that children use mental methods when appropriate, but for calculations that they cannot do mentally they use an efficient written method accurately and with confidence. It is important children acquire secure mental methods of calculation and one efficient written method of calculation for addition, subtraction, multiplication and division which they know they can rely on when mental methods are not appropriate.

This document identifies progression in calculation strategies.

By the end of Year 6, children should be able to choose the most appropriate approach to solve a problem: making a choice between using jottings (an extended written method), an efficient written method or a mental method.

This policy contains the key procedures that will be taught within our school alongside practical resources. It has been written to ensure consistency and progression throughout the school and reflects a whole school agreement.

For a further understanding of mathematics terminology, please see the NCETM 'mathematics glossary' on our school website for an explanation of terms used in each Key Stage.

Recommended websites/ blogs:

<https://www.bbc.co.uk/bitesize/primary>

<https://garethmetcalfe.wordpress.com/>

<http://www.mathematicshed.com/>

<https://trockstars.com/>

<https://nrich.maths.org/>

<https://www.ncetm.org.uk/>

*Note: the terminology of 'ones' and 'units' in the following diagrams is the same concept, meaning a single value.

YEAR 6 - Addition

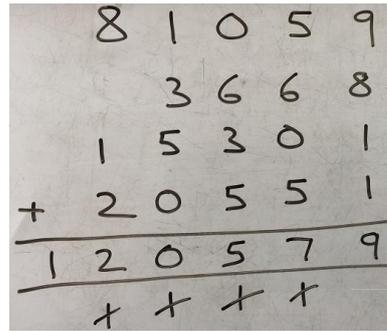
VOCABULARY: order of operations, column addition, add, augend, addend, in total, answer, tens boundary, hundreds boundary, thousands boundary, millions boundary, units boundary, tenths boundary, hundredths boundary, decimal place, inverse

Method:

Example/Representation:

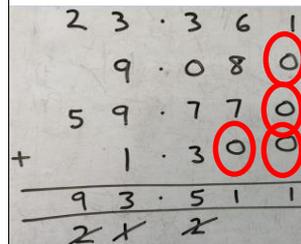
Children will add several numbers of increasing complexity

$$81,059 + 3,668 + 15,301 + 20,551 = 120,579$$



Children will add several **decimals numbers** with a different number of decimal places

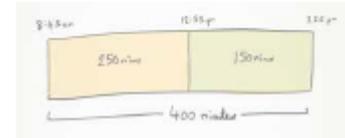
$$23.361 + 9.08 + 59.77 + 1.3 = 93.511$$



Zero used as a place value holder.

Solve multi-step problems using formal jottings – such as the bar model method - and calculations, explaining reasoning behind their calculations.

The time is 12:55pm. If school started at 8:45am and finishes at 3:25pm. What fraction of the day remains?

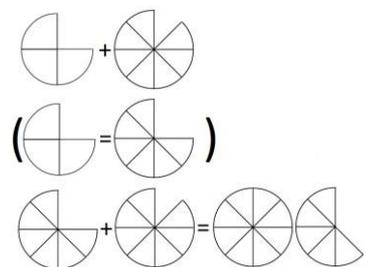


Add fractions and mixed numbers with different denominators using the concept of equivalent fractions

$$\frac{3}{4} + \frac{7}{8} = 1\frac{5}{8}$$

$$\frac{3}{4} \xrightarrow{\times 2} \frac{6}{8} = \frac{6}{8}$$

$$\frac{6}{8} + \frac{7}{8} = \frac{13}{8} = 1\frac{5}{8}$$



EXPECTATIONS:

- Add numbers mentally with increasingly large numbers (e.g. $10,162 + 2,300 = 12,462$)
- Add decimal numbers mentally (up to 2 decimal places)
- For numbers with the same number of digits or decimals, we order based on the size of the most significant digits.
- Use estimation and rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy.
- To know when it is appropriate when (& when not to) use a formal written method.
- Fractions can be compared using benchmarks and equivalent fractions e.g. more than/less than $1/2$.

YEAR 6 – Subtraction

VOCABULARY: order of operations, subtract, decrease, minuend, subtrahend, difference, inverse, decimals, units, tenths and hundredths boundary, column subtraction, decomposition, exchange.

Method:

Children will subtract several numbers of increasing complexity using a **formal column subtraction**

Example/ representation:

$$\begin{array}{r} 6319 \\ - 2527 \\ \hline 61192 \end{array}$$

Children will subtract **decimal numbers with a different number of decimal places** with decomposition.

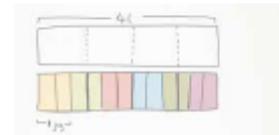
They will be taught to ensure the decimal point is in line, using place value zero as a place value holder if they wish.

$$\begin{array}{r} 3.21 \\ - 1.80 \\ \hline 1.41 \end{array}$$

Zero used as place holder

Children will solve multi-step problems using formal jottings (such as a bar model) and formal calculation methods, **explaining their reasoning** behind their calculations.

Olivia has a container that when filled, holds 4 litres of water. She has some empty jugs that can contain $\frac{2}{3}$ of a litre each. How many jugs can she completely fill?



Children will subtract fractions and mixed numbers with **different denominators** using the concept of equivalent fractions.

$$\begin{array}{l} \frac{4}{6} - \frac{1}{3} = \frac{2}{6} \\ \downarrow \\ \frac{1}{3} = \frac{2}{6} \\ \frac{4}{6} - \frac{2}{6} = \frac{2}{6} \end{array}$$

EXPECTATIONS:

- Subtract increasingly large numbers mentally
- Subtract decimal numbers mentally (up to two decimal places).
- Use approximation and estimation to check answers.
- Number facts can be approximated or calculated by adjusting numbers e.g. $3415 - 2996$ is equivalent to $3419 - 3000$.

YEAR 6 - Multiplication

VOCABULARY: common factors, multiples, prime, prime factors, formal written method, multiply, multiplicand, multiplier, multiplied by, multiple of, product, short and long multiplication, partition, scaling, decimal place, units, tenths and hundredths.

Method:

Multiply numbers by 10, 100 and 1000 where the answers are up to three decimal places

Example/Representation:

$$\begin{array}{l}
 2.345 \times 10 = 23.45 \\
 2.345 \times 100 = 234.5 \\
 2.345 \times 1000 = 2345
 \end{array}$$

$\begin{array}{r}
 \text{Th} \quad \text{H} \quad \text{T} \quad \text{U} \quad \frac{1}{10} \quad \frac{1}{100} \quad \frac{1}{1000} \\
 2 \quad 3 \quad 4 \quad 5 \\
 23.45 \quad (x10) \\
 234.5 \quad (x100) \\
 2345 \quad (x1000)
 \end{array}$

Multiply one-digit numbers with up to two decimal places by whole numbers using:

- Short multiplication when multiplying by a single digit
- Long multiplication when multiplying by a 2-digit number

Ensure the decimal point is in line.

Zero can be used as a place value holder.

$$\begin{array}{l}
 1.27 \times 3 = 3.81 \\
 \begin{array}{r}
 1.27 \\
 \times 3 \\
 \hline
 3.81
 \end{array}
 \end{array}$$

$$\begin{array}{l}
 1.27 \times 15 = 19.05 \\
 \begin{array}{r}
 1.27 \\
 \times 15 \\
 \hline
 6.35 \\
 12.70 \\
 \hline
 19.05
 \end{array}
 \end{array}$$

Multiply multi-digit numbers up to 4 digits by a 2-digit whole number using the formal written method of long multiplication

$$2439 \times 17 = 41463$$

$$\begin{array}{r}
 2439 \\
 \times 17 \\
 \hline
 17073 \\
 24390 \\
 \hline
 41463
 \end{array}$$

$$23.12 \times 12 = 277.44$$

$$\begin{array}{r}
 23.12 \\
 \times 12 \\
 \hline
 46.24 \\
 231.20 \\
 \hline
 277.44
 \end{array}$$

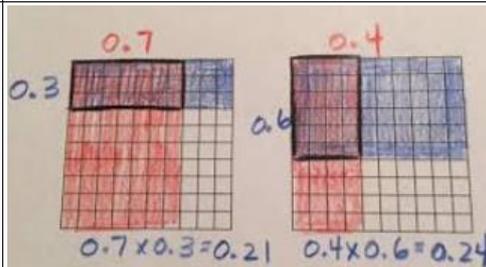
Multiply simple pairs of fractions, writing the answer in its simplest form

$$\frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$$

Pupils use their understanding of the relationship between unit fractions and division to find **fractions of amounts**. They are encouraged to use pictorial representations (e.g. bar model method) to draw out their reasoning and thinking.

$$\begin{array}{l}
 \frac{1}{4} \text{ of } [?] = 36 \\
 \text{means } [?] \div 4 = 36 \\
 \text{Use inverse} \\
 4 \times 36 = [?] \\
 \begin{array}{r}
 36 \\
 \times 4 \\
 \hline
 144
 \end{array} \quad [?] = 144
 \end{array}$$

Solve decimal number problems as whole number problems using the rule: 'the number of decimal digits in the question is the same as the number of decimal digits in the answer'



EXPECTATIONS:

- Identify common factors, common multiples, prime numbers, prime factors and cube numbers.
- Use common factors to simplify fractions mentally
- Use estimation to check answers to calculations and determine, in the context of a problem, levels of accuracy.

YEAR 6 - Division

VOCABULARY: divide, divided by, divided into, divisible by, divisor, dividend, remainder, factor, quotient, inverse, decimal place, units, tenths, hundredths, scaling, formal written methods.

Method:

Use the **formal method for short division** (for divisors to 12).

Example/Representation:

496 ÷ 11 becomes

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

Answer: $45 \frac{1}{11}$

Divide numbers up to 4 digits by a two-digit whole number using **the formal written method of division**. Use multiplication facts to aid the chunking method.

'Chunking' method using known facts:

432 ÷ 15 becomes

$$\begin{array}{r} 28 \\ 15 \overline{) 432} \\ \underline{300} \quad 15 \times 20 \\ 132 \\ \underline{120} \quad 15 \times 8 \\ 12 \end{array}$$

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

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

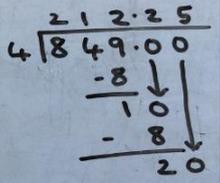
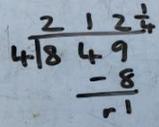
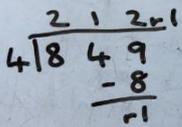
Some children will be taught the following formal method:

432 ÷ 15 becomes

$$\begin{array}{r} 28 \cdot 8 \\ 15 \overline{) 432 \cdot 0} \\ \underline{30} \downarrow \\ 132 \downarrow \\ \underline{120} \downarrow \\ 120 \downarrow \\ \underline{120} \\ 0 \end{array}$$

Answer: 28.8

Interpret remainders as whole number remainders, fractions or decimals

$$849 \div 4 = 212 \text{ r}1 \text{ or } 212\frac{1}{4} \text{ or } 212.25$$


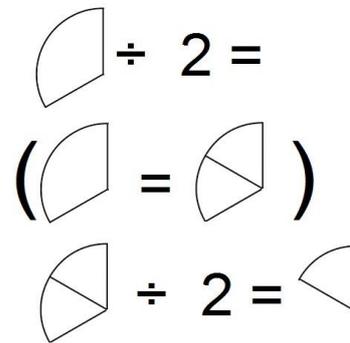
Divide decimal numbers with up to 3 decimal places by 10, 100 and 1000 by moving the digits around a fixed decimal

$$31.2 \div 10 = 3.12$$
$$31.2 \div 100 = 0.312$$
$$31.2 \div 1000 = 0.0312$$

H	T	U	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	$\frac{1}{10,000}$		
3	1	2						
	3	1	2				($\div 10$)	
		0	3	1	2		($\div 100$)	
			0	0	3	1	2	($\div 1000$)

Divide proper fractions by whole numbers

$$\frac{1}{3} \div 2 = \frac{1}{6}$$



EXPECTATIONS:

- Use estimation to check answers to calculations and determine, in the context of a problem, levels of accuracy
- Calculate a fraction of an amount and a % of an amount.