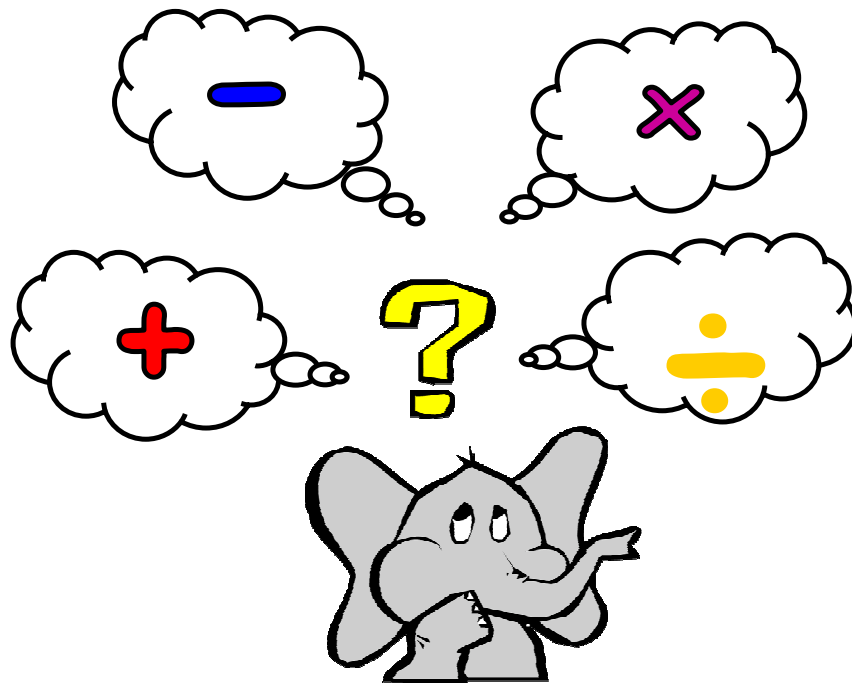


Progression in Calculations Y3 - Y6



St Cecilia's Primary School



St Cecilia's
Catholic Primary School

This booklet sets out the policy for the teaching of written methods for addition, subtraction, multiplication and division.

'Can I do it in my head?' should be the question asked before attempting a calculation. Only if this is not possible should they use a written method. The jottings and methods we teach throughout the school build up to the teaching of standard written methods by year 6.

The methods that are set out in this booklet should be taught in the order and year group in which they appear. There is no benefit in rushing children towards the standard written methods. Using larger numbers rather than methods from the year group above can stretch higher ability children.

If children are not showing competence and confidence in the written methods for their year group it is beneficial to revisit the written methods from the previous year group or to a stage where they understand.

The 'counting up' blank number line method for subtraction appears only in year 3 (method B) but is to be used in any year group when teaching the 'giving change' aspect of money.

Where appropriate the children should be taught to add, subtract or multiply the least significant digit first.

Children should be taught to 'carry' below the line when adding and multiplying in the standard written methods.

When subtracting, children should be taught to 'exchange' tens for units, hundreds for tens, thousands for hundreds etc.

Addition

Year 3

- Partition a number into TU or HTU
- Use informal paper and pencil methods to support, record and explain mental addition of numbers up to 1000
- Explain methods and reasoning, where appropriate in writing

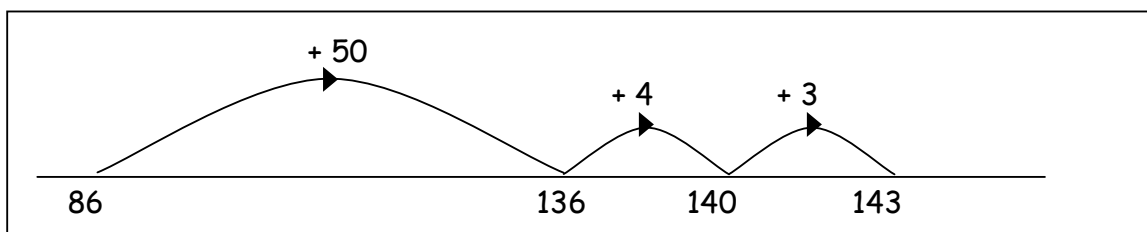
Use informal pencil and paper procedures

Informal recording should include a variety of forms including pictures, number sentences, numberlines - both numbered and blank.

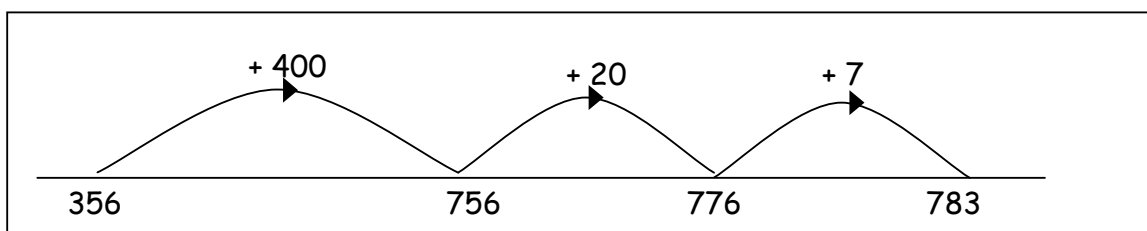
Children need to be competent with partitioning numbers using place value cards.

Method A - Counting on in multiples of 100, 10 or 1 using an empty numberline

$$86 + 57 = 86 + 50 + 7 = 136 + 7 = 143$$



$$\begin{aligned} 356 + 427 &= 356 + (400 + 20 + 7) \\ &= 756 + 20 + 7 \\ &= 776 + 7 \\ &= 783 \end{aligned}$$



Method B - Adding the least significant digits first with informal horizontal recording (not vertical until Y4)

$$67 + 24 = (7 + 4) + (60 + 20) = 11 + 80 = 91$$

$$\begin{aligned} 267 + 85 &= (7 + 5) + (60 + 80) + 200 \\ &= 12 + 140 + 200 \\ &= 352 \end{aligned}$$

Year 5

- Extend written methods to column addition of two integers less than 10 000
- Choose and use appropriate ways of calculating (mental, mental with jottings, written methods, calculator)
- Explain methods and reasoning in writing

Continue to encourage mental methods and informal recording where appropriate.

Method E - Adding the least significant digit first using 'carrying'

Link to expanded method (Y4) - show visually how you move from this to the standard method.

$\begin{array}{r} 346 \\ + 468 \\ \hline 814 \\ \hline 11 \end{array}$	$\begin{array}{r} 4658 \\ + 757 \\ \hline 5415 \\ \hline 111 \end{array}$
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Extend method to numbers with at least four digits and to decimals.

Year 6

- Extend written calculation methods to column addition of numbers involving decimals
- In solving mathematical problems and problems involving "real life", explain methods and reasoning in writing

Continue as for Y5 extending to numbers with any number of digits and several numbers with different number of digits. Extend to decimals.

Subtraction

Year 3

- Partition a number into TU or HTU
- Use informal paper and pencil methods to support, record and explain mental subtraction of numbers up to 1000
- Explain methods and reasoning, where appropriate in writing

Use informal pencil and paper procedures

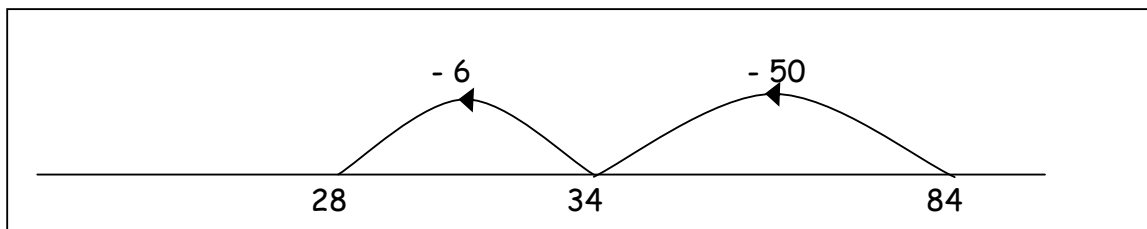
Informal recording should include a variety of forms including pictures, number sentences, numberlines - both numbered and blank.

Children need to be competent with partitioning numbers using place value cards.

Use either counting up or counting back method - whichever is the most appropriate for the numbers involved.

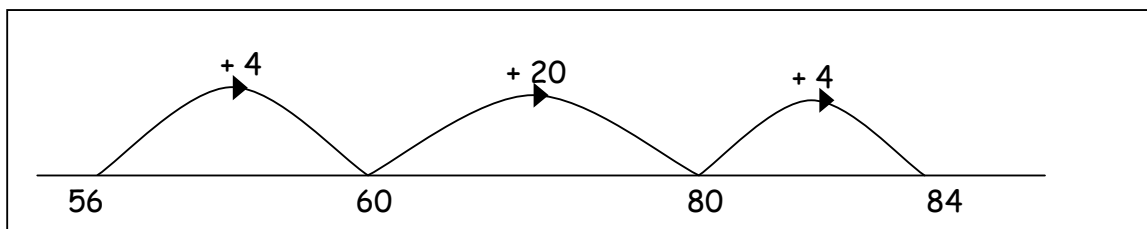
Method A - Counting back

$$\begin{aligned}84 - 56 &= 84 - 50 - 6 \\ &= 34 - 6 \\ &= 28\end{aligned}$$



Method B - Counting up

$$84 - 56 \quad 56 + 4 + 20 + 4 = 84$$



Year 4

- Develop and refine written methods for column subtraction of two whole numbers less than 1000
- Approximate first. Use informal pencil and paper methods to support, record or explain.

Choose and use appropriate ways of calculating (mental, mental with jottings, pencil and paper) to solve problems

Method C - Decomposition (expanded method) - no exchanging

$$93 - 32 = 61$$

$$\begin{array}{r} 93 \\ - 32 \\ \hline 61 \end{array} \longrightarrow \begin{array}{r} = 90 + 3 \\ - 30 + 2 \\ \hline 60 + 1 = 61 \end{array}$$

Progress on to 3 digit numbers with no exchanging.

Method D - Decomposition (expanded method) - with exchanging

$$\begin{array}{r} 754 \\ - 86 \\ \hline \end{array} \longrightarrow \begin{array}{r} = 700 + 50 + 4 \\ \quad 80 + 6 \\ \hline 700 + 40 + 14 \\ \quad 80 + 6 \\ \hline 600 + 140 + 14 \\ \quad 80 + 6 \\ \hline 600 + 60 + 8 = 668 \end{array}$$

Year 5

- Extend written methods to column subtraction of two integers less than 10 000
- Choose and use appropriate ways of calculating (mental, mental with jottings, written methods, calculator)
- Explain methods and reasoning in writing

Continue to develop the expanded method with subtraction of two 3-digit numbers and if appropriate introduce the more standard method involving exchanging. Demonstrate the expanded method alongside the standard method to show the link.

$$\begin{array}{r} 754 \\ - 286 \\ \hline \end{array} \longrightarrow \begin{array}{r} = 700 + 50 + 4 \\ 200 + 80 + 6 \\ \hline 700 + 40 + 14 \\ 200 + 80 + 6 \\ \hline 600 + 140 + 14 \\ 200 + 80 + 6 \\ \hline 400 + 60 + 8 = 468 \end{array}$$

Method E - Standard method

$$\begin{array}{r} \\ 754 \\ - 286 \\ \hline 468 \end{array}$$

Year 6

- Extend written calculation methods to column subtraction of numbers involving decimals
- In solving mathematical problems and problems involving "real life", explain methods and reasoning in writing

Continue as for Y5 extending to numbers with any number of digits and several numbers with different number of digits. Extend to decimals.

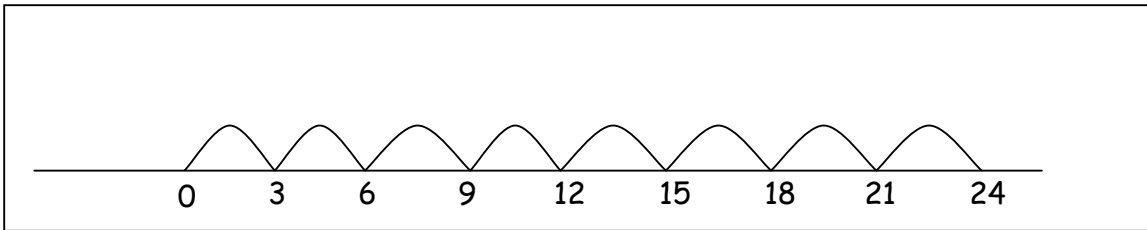
Multiplication

Year 3

- Know by heart facts for the 2, 5 & 10 multiplication tables
- Understand multiplication as repeated addition
- Understand multiplication as describing arrays
- Multiply a single digit by 10 or 100
- Multiply a two-digit multiple of 10 up to 50 by 2,3, 4, 5 or 10
- Choose and use appropriate operations to solve word problems, explaining methods and reasoning

Method A - Using a blank numberline for repeated addition

$$8 \times 3 =$$



Begin to partition and use to check results of calculations

$$24 \times 2 =$$

$$(20 \times 2) + (4 \times 2)$$

$$(40) + (8) = 48$$

Year 4

- Know by heart facts for the 2,3,4,5 & 10 multiplication tables
- Choose and use appropriate number operations and ways of calculating (mental, mental with jottings, pencil & paper) to solve problems

Method B - Partition and use the distributive law

$$\begin{aligned} 22 \times 3 &= (20 \times 3) + (2 \times 3) \\ &= 60 + 6 \\ &= 66 \end{aligned}$$

Method C - Grid Method (TU x U)

$$34 \times 6 = 204$$

x	30	4	
6	180	24	= 204

Year 5

- Multiply any positive integer up to 10,000 by 10 or 100 and understand the effect.
- Know by heart all multiplication facts up to 10 x 10
- Extend written methods to short multiplication of HTU or U.t by U
- Extend written methods to long multiplication of TU by TU
- Estimate by approximating (round to nearest 10 or 100), and then check result.

Method D - Short Multiplication

$$349 \times 9 =$$

X	300	40	6	
9	2700	360	54	= 3114

346	
x 9	
54	(6 x 9)
360	(40 x 9)
2700	(300 x 9)
<u>3114</u>	

Method E - Long Multiplication

$$72 \times 38 =$$

x	70	2	
30	2100	60	= 2160
8	560	16	= 576
			<u>2736</u>

	72	
x	<u>38</u>	
	16	(2 x 8)
	560	(70 x 8)
	60	(2 x 30)
	<u>2100</u>	(7 x 30)
	2736	

Extend to decimals using the partition and grid methods.

Year 6

- **Multiply decimals mentally by 10 or 100 and integers by 1000 and explain the effect.**
- **Identify and use appropriate operations including combinations of operations to solve word problems involving numbers and quantities.**
- **Extend written methods to multiplication of ThHTU x U**
- **Short multiplication of numbers involving decimals**
- **Long multiplication of a three-digit by a two-digit integer**

Continue with grid method for ThHTU x U and HTU x TU. If appropriate extend to vertical layout.

For short multiplication of ThHTU x U could extend to standard layout.

$$\begin{array}{r} 4346 \\ \times 8 \\ \hline 34768 \\ 234 \end{array}$$

For the majority of Y6 pupils it is probably most appropriate not to progress beyond the grid method especially for long multiplication.

For more able children - Long Multiplication (standard method)

$$\begin{array}{r} 352 \\ \times 27 \\ \hline 2464 \\ 7040 \\ \hline 9504 \\ 1 \end{array}$$

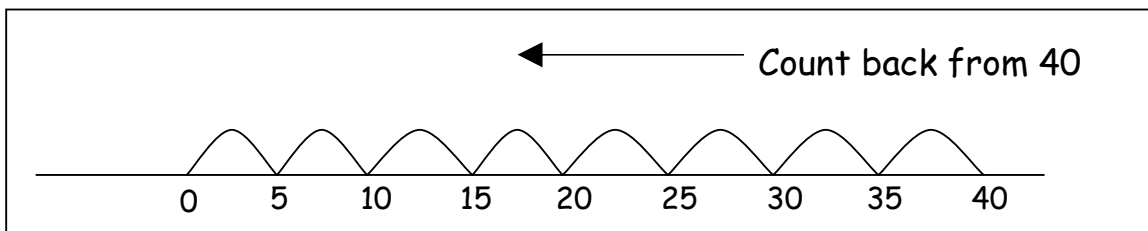
Division

Year 3

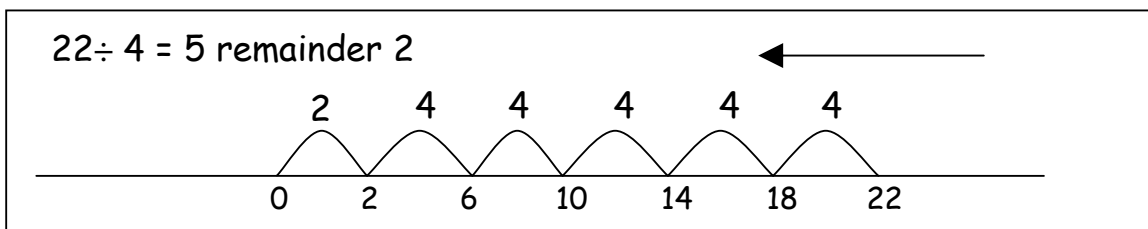
- Derive quickly division facts corresponding to 2, 5 & 10 times table
- Understand division as grouping and repeated subtraction and recognise that division is the inverse of multiplication and halving is the inverse of doubling
- Begin to find remainders after simple division
- Round up or down after division depending on the context
- Say or write a division statement corresponding to a multiplication statement
- Check division with multiplication
- Link fractions with division eg $\frac{1}{2}$ means one divided into two equal parts

Method A - Grouping using a numberline

How many 5's in 40?



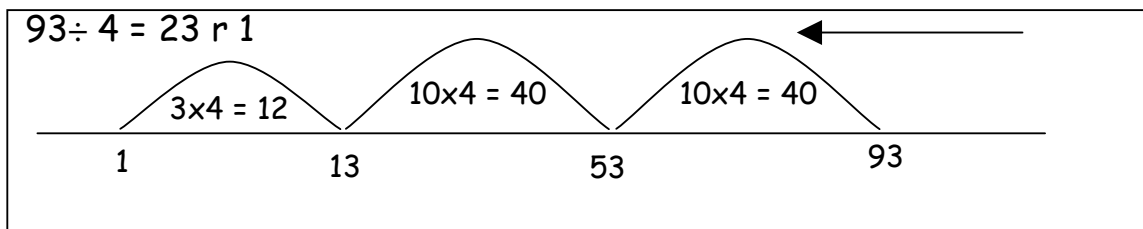
Grouping with remainders - repeated subtraction - counting back links with 'chunking'



Year 4

- Derive quickly division facts corresponding to the 2,3,4,5 & 10 multiplication tables
- Find remainders after division

Method B - Repeated subtraction using multiples of the divisor (chunking)



Leading to

$$\begin{array}{r} 96 \div 6 = \quad 6 \overline{) 96} \\ \quad \underline{-60} \quad (10 \times 6) \\ \quad \quad 36 \\ \quad \quad \underline{-36} \quad (6 \times 6) \\ \quad \quad \quad 0 \end{array} \quad \text{Ans: 16}$$

Year 5

- Divide any positive integer up to 10,000 by 10 or 100 and understand the effect.
- Carry out short division of a three digit by a single digit integer.
- Relate fractions to division and to their decimal representations.
- Emphasise link with language $12/3$ means $12 \div 3$ and $3 \div 4$ is the same as $\frac{3}{4}$
- Derive quickly division facts corresponding to table up to 10×10 .

$$\begin{array}{r} 196 \div 6 = \quad 6 \overline{) 196} \\ \quad \underline{-180} \quad (30 \times 6) \\ \quad \quad 16 \\ \quad \quad \underline{-12} \quad (2 \times 6) \\ \quad \quad \quad 4 \end{array} \quad \text{Ans: 32 R 4}$$

Leading to

$$\begin{array}{r} 196 \div 6 = \quad 6 \overline{) 196} \\ \quad \quad \quad 32 \text{ R } 4 \\ \quad \quad \underline{-18} \\ \quad \quad \quad 16 \\ \quad \quad \quad \underline{-12} \quad (2 \times 6) \\ \quad \quad \quad \quad 4 \end{array}$$

Year 6

- Divide decimals mentally by 10 or 100 and integers by 1000 and explain the effect.
- Derive quickly division facts corresponding to multiplication facts to 10×10 .
- Express a quotient as a fraction or as a decimal rounded to one decimal place.
- Round up or down after division depending on the context.
- Include examples of calculator answers for money eg. express 3.6 as £3.60
- Short division of TU or HTU by U involving decimals (Mixed number answer).
- Division of HTU by TU (Whole number answer).

Continue as Y5 but extend to long division $\text{HTU} \div \text{TU}$ and decimals with up to two decimal places.

Method C – Long division $\text{HTU} \div \text{TU}$ (chunking method)

$$\begin{array}{r} 36 \overline{) 972} \\ \underline{-720} \quad (20 \times 36) \\ 252 \\ \underline{-252} \quad (7 \times 36) \\ 0 \end{array} \quad \text{Ans: } 27$$