Wimborne Junior School Calculation Policy

At Wimborne Junior School, we want all children to have a conceptual understanding of all the formal written methods. The aim is that all children will be fluent in these written methods and be able to explain the process confidently.

Our new calculation policy aims to allow children to progress through at their own ability, rather than putting a limit on their learning, by stating a year group for each method. Children need to be developing a deeper understanding alongside learning the process of each method. This may mean that for each new year group objective, they may need to recap a practical or non-standard method before becoming secure with the formal method.

By the end of Year 6, children should be secondary ready, confidently using all formal written methods, with a secure understanding of what each operation means (e.g. 37 x 4 means 4 lots of 37 and children should know that this can be represented in a variety of ways).

Each operation has been split into 3 areas:
Year group objectives for that operation – these are what children need to be able to do, in order to be operating at age-related expectations.
Procedures – children need to be fluent in these skills and recognise when to use each method, or, recognise when there may be a shorter route (e.g. sometimes times tables are quicker to use than short division; counting on might be quicker than completing a column subtraction with lots of 0s; etc).
Conceptual Understanding – this shows the children that have a real understanding of how to manipulate numbers using the written procedures.

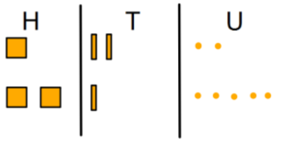
Year group objectives for Addition	Year 3: • I can add numbers up to 3 digits, using an efficient written method. • I can solve addition problems. • I can estimate the answer to a calculation and use inverse operations to check. • I can solve missing number problems. Year 4: • I can add numbers with up to 4 digits, using efficient methods. • I can estimate to check answers to a calculation. • I can use inverse operations to check answers to a calculation. • I can solve addition two-step problems, deciding which operations and methods to use and why. Year 5: • I can add whole numbers with more than 4 digits. • I can use rounding to check answers to calculations. • I can use addition and subtraction to solve multi-step problems. Year 6: • I can solve addition multi-step problems in contexts, deciding which operations and methods to use and why. • I can solve problems, involving addition. • I can use estimation to check answers to calculations.

Progress in Addition

Children should be secure with the process of column addition at each stage before exchange is introduced.

Expanded Column Method

Practical:



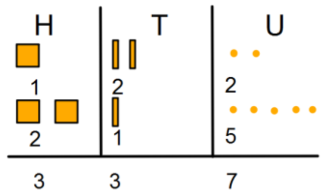
122 + 215 = 337

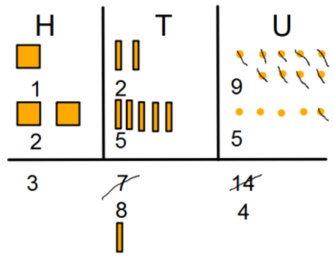
Written:

H	T	U
100	20	2
200	10	5
300	30	7

Column Method

Practical:





Written:

```
  7648        6584
+ 1486      + 5848
  9134       12432
  1 11        1 11
```

```
     42
   6432
    786
      3
 + 4681
  11944
   121
```

Conceptual Understanding

Eleven

Replace each letter with a digit to make this addition correct.

```
    T H R E E
    T H R E E
+     F O U R
-------------
  E L E V E N
```

Read This Page

Replace the letters with numbers to make the addition work out correctly.

```
    R E A D
  + T H I S
  ---------
    P A G E
```

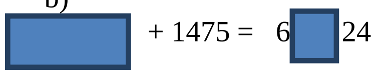
Convince me

The total is 201
Each missing digit is either a 9 or a 1.
Write in the missing digits.
Is there only one way of doing this or lots of ways?
Convince me

Convince me

a) Three four digit numbers total 12435.
What could they be?
Convince me

b)



What numbers go in the boxes?
What different answers are there?
Convince me

Year group objectives for Subtraction	Year 3: • I can subtract numbers up to 3 digits, using an efficient written method. • I can solve subtraction problems. • I can estimate the answer to a calculation and use inverse operations to check. • I can solve missing number problems. Year 4: • I can subtract numbers with up to 4 digits, using efficient methods. • I can estimate to check answers to a calculation. • I can use inverse operations to check answers to a calculation. • I can solve subtraction two-step problems, deciding which operations and methods to use and why. Year 5: • I can subtract whole numbers with more than 4 digits. • I can use rounding to check answers to calculations. • I can use subtraction to solve multi-step problems. Year 6: • I can solve subtraction multi-step problems in contexts, deciding which operations and methods to use and why. • I can solve problems, involving subtraction. • I can use estimation to check answers to calculations.

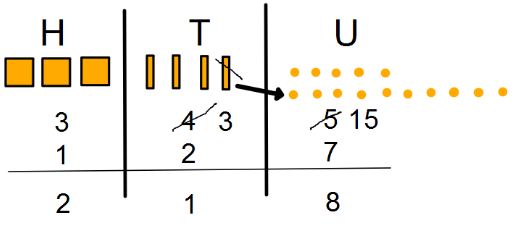
Progress in Subtraction

Children should be secure with the process of column subtraction at each stage before exchange is introduced.

Expanded Column Method

Practical Column Method

345 – 127



345 - 127 = 218

Written

$$
\begin{array}{r} 754 \\ -\ 86 \\ \hline \end{array}
$$

Step 1   700 + 50 + 4 − 80 + 6

Step 2   700 + 40 + 14 − 80 + 6 *(adjust from T to U)*

Step 3   600 + 140 + 14 − 80 + 6 *(adjust from H to T)*

600 + 60 + 8 = 668

This would be recorded by the children as

$$
\begin{array}{rcrcr} \overset{600}{\cancel{700}} & + & \overset{140}{\cancel{50}} & + & {}^{1}4 \\ - & & 80 & + & 6 \\ \hline 600 & + & 60 & + & 8 = 668 \end{array}
$$

Column Method

874 – 523 becomes

$$
\begin{array}{r} 8\ 7\ 4 \\ -\ 5\ 2\ 3 \\ \hline 3\ 5\ 1 \\ \hline \end{array}
$$

Answer: 351

932 – 457 becomes

$$
\begin{array}{r} \overset{8}{\cancel{9}}\ \overset{12}{\cancel{3}}\ \overset{1}{2} \\ -\ 4\ 5\ 7 \\ \hline 4\ 7\ 5 \\ \hline \end{array}
$$

Answer: 475

Conceptual Understanding

Subtracting to 2008

In this subtraction, *P*, *Q*, *R* and *S* are digits. What is the value of *P*+*Q*+*R*+*S*?

$$
\begin{array}{r} 8\ Q\ 0\ S \\ -\ P\ 0\ R\ 2 \\ \hline 2\ 0\ 0\ 8 \end{array}
$$

Convince me

What digits could go in the boxes?

7☐ - ☐2 = 46

Try to find all of the possible answers.

How do you know you have got them all? Convince me

Convince me

☐ - 666 = 8☐5

What is the largest possible number that will go in the rectangular box?

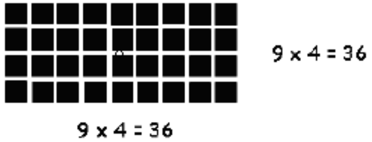
What is the smallest? Convince me

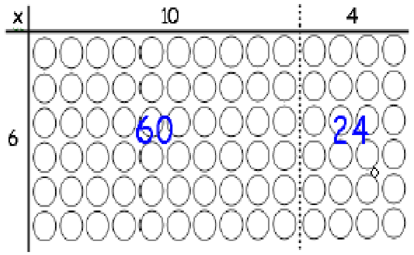
Year group objectives for Multiplication	Year 3: • I can use efficient written methods to multiply a 2 digit and a 1 digit number. • I can solve multiplication problems. Year 4: • I can multiply 2 digit numbers by 1 digit numbers. • I can multiply 3 digit numbers by one digit numbers. • I can solve multiplication problems. Year 5: • I can multiply numbers up to 4 digits by a one or 2 digit number. • I can solve multiplication problems. Year 6: • I can multiply multi-digit numbers, up to 4 digits, by a 2 digit whole number. • I can solve problems, involving multiplication. • I can use estimation to check answers to calculations.

Progress in Multiplication

Children should be secure with the process of long and short multiplication before being moved on to exchanging.

Arrays





(6 x 10) + (6 x 4)

60 + 24

84

This leads into grid method – children need to see the need for a more efficient method as the numbers increase in size.

Grid Method

X	10	4
6	60	24

```
 60
 24
---
 84
---
```

Short Multiplication

This needs to be 'opened out' so that children understand how this has developed from the grid method, before being condensed down and exchanging numbers across each column.

342 × 7 becomes

```
    3 4 2
 ×      7
 --------
  2 3 9 4
 --------
    2 1
```

Answer: 2394

2741 × 6 becomes

```
    2 7 4 1
 ×        6
 ----------
  1 6 4 4 6
 ----------
    4 2
```

Answer: 16 446

Long Multiplication

This needs to be 'opened out' so that children understand how this has developed from the grid method, before being condensed down and exchanging numbers across each column

124 × 26 becomes

```
   1 2
   1 2 4
 ×   2 6
 -------
 2 4 8 0
   7 4 4
 -------
 3 2 2 4
 -------
 1 1
```

Answer: 3224

124 × 26 becomes

```
   1 2
   1 2 4
 ×   2 6
 -------
   7 4 4
 2 4 8 0
 -------
 3 2 2 4
 -------
 1 1
```

Answer: 3224

Long multiplication

24 × 16 becomes

```
   2
   2 4
 × 1 6
 -----
 2 4 0
 1 4 4
 -----
 3 8 4
 -----
```

Answer: 384

Conceptual Understanding

How close can you get?

□ □ × □

Using the digits 2, 3 and 4 in the calculation above how close can you get to 100? What is the largest product? What is the smallest product?

Prove It

What goes in the missing box?

x	?	?
4	80	12

Prove it.

How close can you get?

□ □ □ X 7

Using the digits 3, 4 and 6 in the calculation above how close can you get to 4500? What is the largest product? What is the smallest product?

ABC

The digits in this multiplication have been replaced. Different letters mean different digits.

```
       A B C
       B A C
     -------
     * * * *
     * * A
 * * * B
 -----------
 * * * * * *
```

Year group objectives for Division	Year 3: • I can solve division problems. Year 4: • I can solve division problems. Year 5: • I can divide numbers up to 4 digits by a 1 digit number. • I can solve division problems. Year 6: • I can divide numbers, up to 4 digits, by a 2 digit whole number. • I can solve problems, involving division. • I can use estimation to check answers to calculations.

Progress in Division

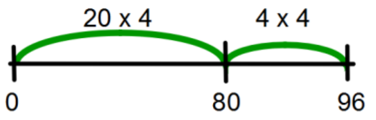
Children need to be clear of the 2 different structure in division, and the context that these might be seen in.

These need to be clear, before formal written methods are introduced.

Grouping Structure

This links closely to times tables and arrays. Children need to understand that division can sometimes be asking:
'If it put sweets into groups of 4, how many groups would I get with 96 sweets?'

96 ÷ 4 = 24

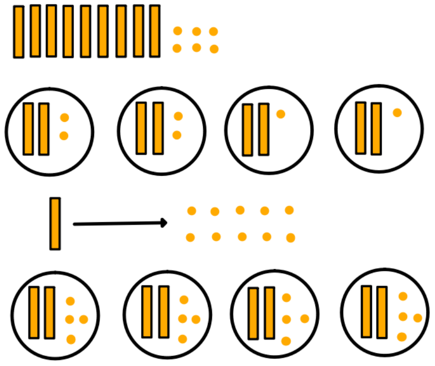


This number line can be presented in a variety of ways.
Vertically, going forwards or going backwards.

Sharing Structure

This structure is about sharing out are set of objects, and children need to understand the sharing structure is often seen when asked:
'I have 96 sweets, how many would 4 friends get?'

96 ÷ 4 = 24



Share out the tens sticks evenly, when they can't be shared out equally, the ten needs to be exchanged for ten ones.

The Remainders Game

Your partner thinks of a number between 1 - 100. Can you work out what it is?
Choose a divisor between 2 and 10. Your partner will tell you the remainder after the division See if you can work out the number they are thinking of based on this information.

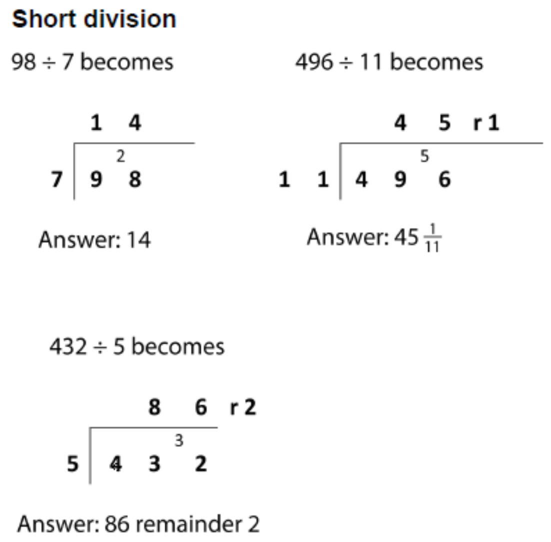
If you guess correctly after
2 divisions - you gain 10 points
3 divisions - you gain 9 points
4 divisions - you gain 8 points
5 divisions - you gain 7 points
6 divisions - you gain 6 points
7 divisions - you gain 5 points
8 divisions - you gain 4 points
9 divisions - you gain 3 points

If you guess wrong you lose 5 points, even if your guess satisfies the criteria, so don't guess until you are certain that there is only one possible answer.
Each division you carry out must provide new information - it must rule out some numbers. If you carry out unnecessary divisions you gain 0 points, even if your eventual guess is correct.

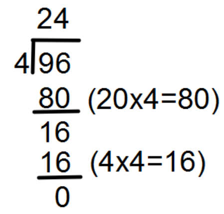
Progress in Division

Written methods should only be introduced and used when children have a really clear understanding of the concept of division, and are securely using resources to show this.

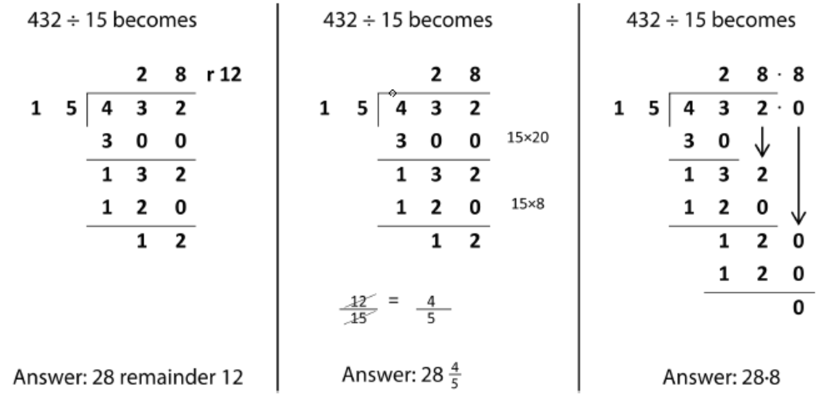
Short division



Annotated Long Division - leading to Long Division



Children record the answer as they go rather than 'chunking' to add at the end



Conceptual Understanding

Prove It

What goes in the missing box?

12 ☐ 2 ÷ 6 = 212

14 ☐ 4 ÷ 7 = 212

22☐ 3 ÷ 7 = 321 r 6

Prove it

Digital Division

Consider all three-digit numbers formed by using *different* digits from 0, 1, 2, 3 and 5. How many of these numbers are divisible by 6?

American Billions

Alison and Charlie are playing a divisibility game with a set of 0–9 digit cards.

They take it in turns to choose and place a card to the right of the cards that are already there.

- After two cards have been placed, the two-digit number must be divisible by 2.
- After three cards have been placed, the three-digit number must be divisible by 3.
- After four cards have been placed, the four-digit number must be divisible by 4.

And so on!

They keep taking it in turns until one of them gets stuck
Are there any good strategies to help you to win?
What's the longest number you can make that satisfies the rules of the game?
Is it possible to use all ten digits to create a ten-digit number?
Is there more than one solution?