Fingringhoe C of E
(VA) Primary School

Mathematics - 4 Rules Calculation Policy

Approved by Governors: January 2017

Review: January 2019

Mathematics- Four Rules Policy

This policy is aimed to help staff and parents in the understanding of, and progression in the four rules in written calculations. This policy recognises that pupils'mental number knowledge and skills are of prime importance. The policy contains guidance for progression, which the majority of pupils will make. It **does not** set out a system of progression that every child must go through.

It is expected that **addition/subtraction** and **multiplication/division** be taught along side each other so that pupils can see and use the relationship between them. It is important for pupils to recognise **multiplication as repeated addition** and **division as repeated subtraction.** Pupils should be encouraged and taught to estimate their answers and check calculations by using the inverse operation and a variety of strategies. It is recommended that pupils are encouraged to use jottings to support calculations. In addition to this, the Concrete, Pictorial and Abstract Model (CPA) should be read in conjunction with this policy and inform teaching and learning. (Appendix A)

Addition

Step one

In the early stages, show children strategies for successful counting…

- *Model touching each object once as you say a number*
- *Move each object, touch each object*
- *Count things that can be seen but not moved such as paintings on the window*
- *Count sounds e.g. coin drops into an empty tin*
- *Model counting objects systematically, e.g. point to one at a time from top to bottom, left to right.*
- *When counting objects, discuss with the children what they would do to make counting easier, e.g. put them in a line, move them as we count*
- *Discuss where we start when counting objects so that objects are not counted twice*
- *Encourage instant recognition of one, two or three dots by providing dice and dominoes in play.*
- *Practice estimating objects in small sets*

Underpinning mental and oral skills, knowledge and understanding
Pupils will be saying and using number names in order in familiar contexts
Count reliably to 5, then 10 and beyond using everyday objects
Recognise numerals 1 to 9
Use practical activities and discussion

Adding on one more
For example:

Using counters to count on in ones:
○○○○○○○ + ○ this makes 8

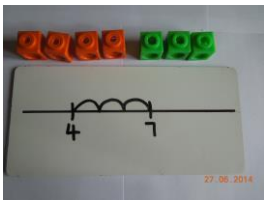
Teachers could use number lines.

+1 +1 +1 +1 +1 +1
→ → → → → →
0 1 2 3 4 5 6

Begin to record / mark making in the context of play or practical activities and problems
For example:
Writing shopping bills in the class shop, marks and stamps.
When a count is started by another child, one, two, three …continue four, five six…

Step two
Mental methods need to be secure. Pupils will be encouraged to start from the largest number; this may require them to record their calculation. When calculating answers pupils will need to build on mental methods by counting on in ones from a given number, such as 4 or 8.
Number lines can be used. Number tracks, number lines, 100 grids can be used to support as can Numicon, cubes and any other counting apparatus.



+1 +1 +1 +1 +1 +1
→ → → → → →
4 5 6 7 8 9

Using empty number lines with jumps or steps can also be used as an aid to counting on in single digits.
Develop the concept of number bonds, initially to ten and then 20.
Understand related facts e.g. 3 + 4 = 7, 4 + 3 = 7, 7 = 3 + 4, 7 = 4 + 3

Step three

Counting on in ones, but in conjunction with two digit numbers
For example:
Count on in ones from 14
Count on in ones from 30
Also pupils could be recording written calculation with empty boxes for example:

3 + 4 = □

13 + 4 = □

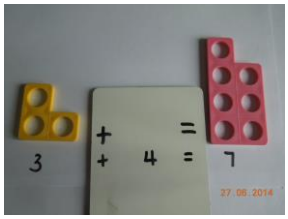
Develop secure use of number bonds to reinforce working within this step.
Develop understanding of equals sign through use of empty box questions.

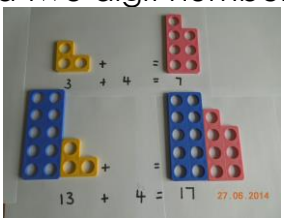
13 + □ = 17 which can be turned into a subtraction: □ = 17 - 13

Consistent use of these formats and empty number lines encourage pupils to estimate answers.
Pupils use understanding of patterning, place value and partitioning to develop number facts. e.g. 3 + 4 = 7 (known fact)

13 + 4 = 17
23 + 4 = 27

Begin to use understanding of place value and partitioning to carry out addition of one and two digit numbers.

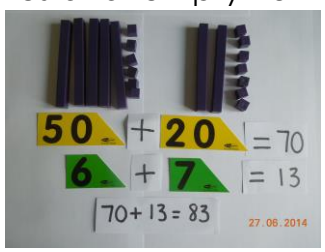




Step four

Mental methods need to be secure. Pupils will be encouraged to start with the largest number; this may require them to record the calculation.
2 digits + 1 digit (10s 1s + 1s) and then 2 digits + 2 digits (10s 1s + 10s 1s), developing understanding of partitioning and place value to support addition.
32 + 7
30 + 2 + 7
30 + 9 = 39

Using practical apparatus to support this, such as arrow cards, marked number lines,100 squares and empty number lines.



When pupils are calculating answers they will need to build on mental methods by counting up in tens first.
Number lines could be used.

Example: 27 + 56 = 56 + 27 = (56 + 10 + 10) + 7

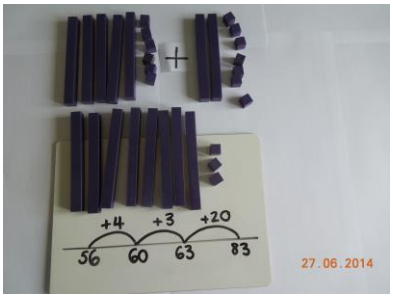
+ 10 → + 10 → + 4 → +3 →

56 66 76 80 83

Step five

2 digits + 2 digits (10s 1s + 10s 1s) and 3 digits + 2 digits (100s 10s 1s + 10s 1s)

Pupils will be encouraged to add the least significant number first so that when they make up the step to a formal compact layout it is not unusual for them to add the ones (units) first.
Number lines could also be used.
Example: 27 + 56 = (7 + 6) + (20 + 50) or
27 + 56 = (56 + 7) + 20



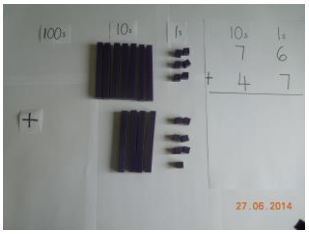
+4 → +3 → +20 →

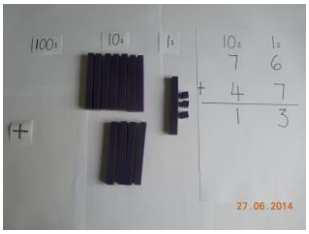
56 60 63 83

Pupils to decide when it is best to use mental strategies. Practical apparatus used to support this such as marked number lines, 100 squares, base ten, Numicon and empty number lines.

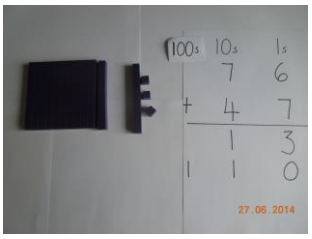
Step six

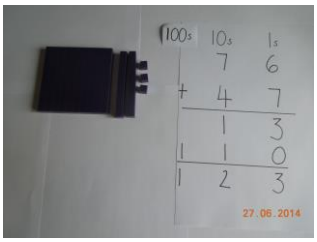
Continue to decide when mental strategies are best used for calculations. When using written methods, continue to use apparatus to support, initially without carrying and then introducing carrying.
Pupils are to be shown and taught the expanded addition method of a calculation, which shows the addition of the tens and the addition of the ones separately.
Example:





100s	10s	1s
	7	6
+	4	7
	1	3
1	1	0
1	2	3





Becomes

100s	10s	1s
	4	7
+	7	6
1	2	3
	1	

Step seven

For pupils to extend on step three with encouraging them to use bigger numbers and make use of checking methods such as the inverse operation.

Example:

100s	10s	1s
3	6	8
+ 4	9	3
	1	1
1	5	0
7	0	0
8	6	1

This becomes:

100s	10s	1s	
3	6	8	
+	4	9	3
8	6	1	
1	1		

Step eight

Pupils to extend step seven with larger numbers and decimal numbers they may need to initially revert to a more expanded layout before being confident and independent with the compact method.

Subtraction

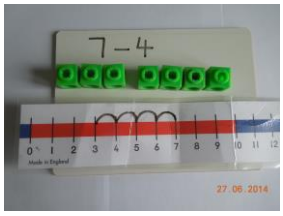
Step one

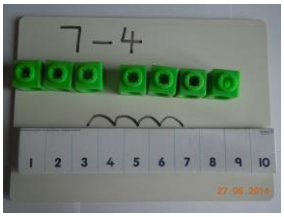
Counting on and back in ones up to ten, using apparatus and reinforce through songs. Children should relate subtraction to take away and to counting back.

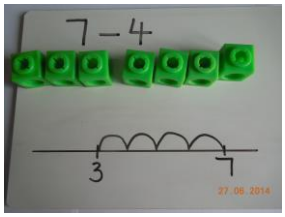
Find one more/ less using number lines, practical resources and word problems put into context.

Step two

To count back using number tracks, number lines, 100 square to support the development of the concept of subtraction as take away.







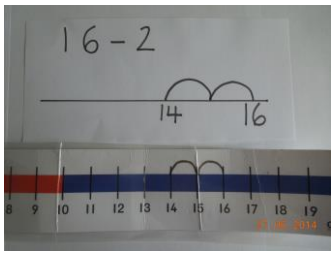
Develop subtraction facts to ten and then to 20. Record related number facts and make links to addition. e.g. 7 – 4 = 3, 7 – 3 = 4

To count on and back in tens from/ to

zero.

Step three

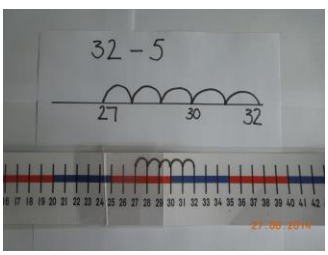
Develop understanding of the equals sign and the concept of 'empty box' questions so pupils are able to respond to questions like 8 - ? = 3
Use understanding of place value, patterning and partitioning to derive number facts e.g. 6 – 2 = 4 (known fact)
16 – 2 = 14
26 – 2 = 24

Begin to use understanding of place value and partitioning to support subtraction of one digit and two digit numbers using number lines.

Step four

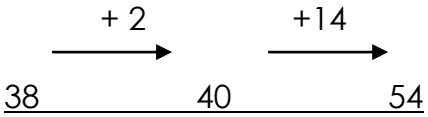
2 digits – 1 digit
Continue to develop understanding of partitioning and place value to support subtraction. Record in horizontal format and use empty number lines, 100 squares and marked number lines to support.
32 – 5
32 – 2 – 3
To find a small difference by counting on in ones.
Counting on in tens from any single digit number.

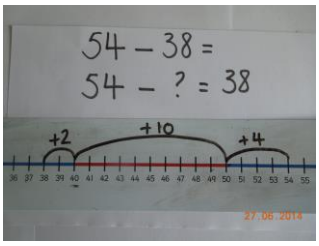


Step five

Counting on to find difference between 2 digits – 1 digit and 2 digits – 2 digits.
Use number bonds to find the next multiple of ten.
To count up in tens from any two digit number, support using 100 square.
Recording calculations on marked number lines then empty number lines.

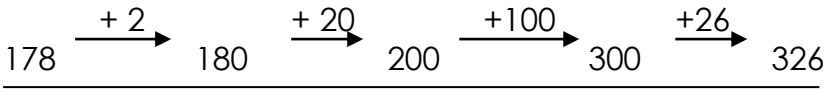
Example: 54 – 38 = 16





Step six

Counting on to find difference between 3 digits – 2 digits and 3 digits – 3 digits.
(Y3 Abacus)
Jumping to next multiple of 10 and 100, reducing amount of jumps needed to find difference.
Example:



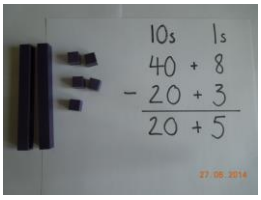
Step seven

Pupils will need to decide which method is best to use to solve calculation. Expanded method for subtraction is introduced using apparatus to support. Pupils can set out their calculations vertically, that they can do mentally already. It may be useful to model expanded method alongside empty number line for counting up.
2 digits – 2 digits (10s 1s subtract 10s 1s)
moving onto 3 digits – 2 digits (100s, 10s + 1s subtract 10s and 1s)

With no exchange:

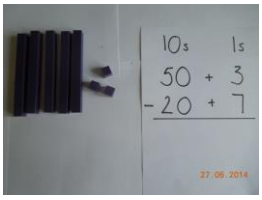
10s	1s
4	8
- 2	3
2	5

10s	1s
40	+ 8
- 20	+ 3
20	+ 5 = 25



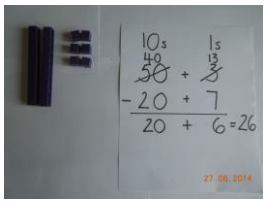
With exchange:

10s	1s
40	13



```
  5   3
- 2   7
```

```
 50  + 3
- 20  + 7
 20  + 6 = 26
```



Step eight

Pupils extend the use of the expanded method to solve 3 digits – 3 digits (Abacus Y4) Continuing to offer apparatus, such as base 10, to support.

Pupils determine which calculations are best carried out mentally or with jottings.

With no exchange:

```
   100s  10s  1s
    7     2    6
-   3     1    4
    4     1    2
```

```
 100s   10s   1s
        700 + 20 + 6
-       300 + 10 + 4
        400 + 10 + 2  = 412
```

With exchange

```
   100s  10s  1s
    7     2    9
-   3     4    5
```

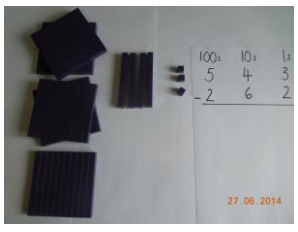
```
 100s   10s   1s
 600    120
 700  + 20  + 9
-       300 + 40 + 5
 300   +80   + 4 = 384
```

Step nine

Introduce compact method for subtraction, initially alongside expanded method (Abacus Y4). For 3 digit – 3 digit (100s, 10s and 1s subtract 100s, 10s and 1s) calculations and higher.

```
   100s  10s  1s
   400   140
 - 500 + 40 + 3
-  200 + 60 + 2
    200 + 80 + 1 = 281
```

```
 100s  10s  1s
       4    14
   5    4    3
-  2    6    2
   2    8    1
```

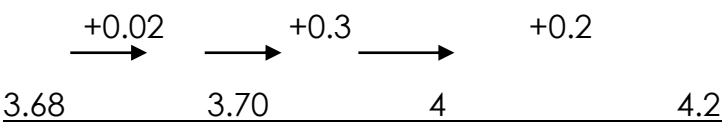


Step ten

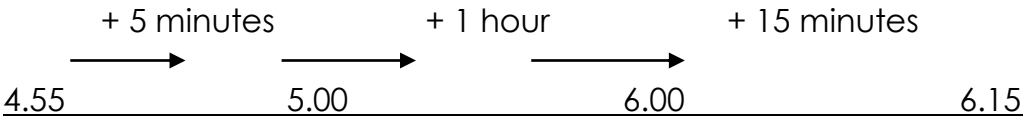
Continue to use compact method for subtraction for larger numbers and decimals.

The empty number line is useful to use at any stage of development for the following areas:

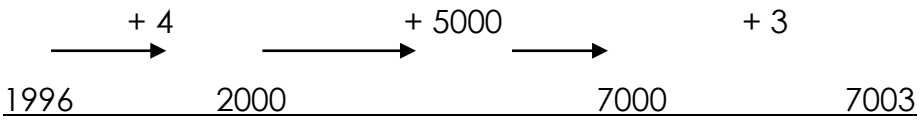
Decimals e.g. 4.2 – 3.68 =



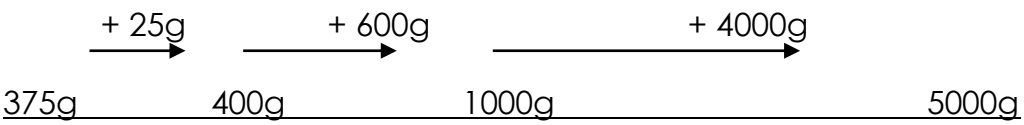
Elapse time e.g. find the difference between 04.55 and 06.15



Numbers containing zeros e.g. 7003 – 1996 =



Conversion in measure – capacity, length etc. e.g. 5kg – 375 g =

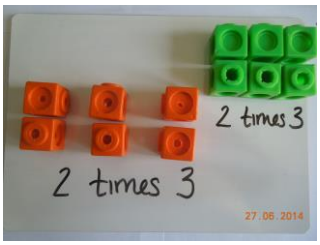


Multiplication

Step one

Count on and back in 1s, 2s, 5s, 10s.
Using mental strategies to solve simple problems by doubling, explaining methods and reasoning orally in order to help understanding- 'picture it'.
Doubles of numbers to 12. Combining groups of 2,5, and 10.

Step two



Pupils understand the operation of multiplication as repeated addition/ grouping using practical apparatus and diagrams.

Understand multiplication using arrays.

Number lines are used to show repeated groups (repeated addition of sets of the same size).

To know by heart, (orally), facts for the 2, 5 and 10 times-tables.
Children count repeated groups of objects. For example, they count socks into 9 pairs, the number of pens in five packs of ten. They count 5p coins or work out where they will land after six hops of five from zero on a number line.

Step three

Develop the use of x and = symbols to record calculations horizontally.
Use arrays and other practical apparatus to illustrate commutativity (the multiplication calculations can be carried out in any order) e.g. 2 x 4 

arrives at the same product as 4 x 2.

Begin to derive new facts from known facts
e.g. 3 x 2 = 6 (known fact) also 3 x 2 = 6
30 x 2 = 60 3 x 4 = 12
300 x 2 = 600 3 x 8 = 24

Build knowledge of other multiplication facts, including 3,4,6,9,8,7

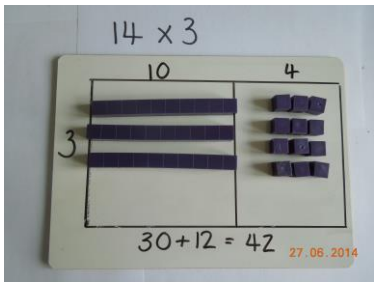
Step four

Mental method, using **partitioning**. Pupils need to be secure in their times table knowledge. To aid pupils when they reach the compact method they should multiply the least significant numbers first.
Multiplying 2 digits by 1 digit.
Example: 14 x 3 = (4 x 3) + (10 x 3)

Grid method. Estimating of answers should be encouraged.
Practical apparatus to support, such as base 10. (Abacus Y3)
Example:

x	10	4
3	30	12

14 x 3 = 42



Step five

Extended written calculations to 3 digits x 1 digit, then 4 digits x 1 digit

Develop grid method, using apparatus to support

x	300	40	7
6	1800	240	42

	1000s	100s	10s	1s	
	1	8	0	0	
		2	4	0	
+				4	2
	2	0	8	2	347 x 6 = 2082
	1				

Develop expanded recordings in columns, sometimes called ladder method, and then move to formal written method, using practical resources to support when required.

100s 100s 10s 1s 1000s 100s 10s 1s

```
      3   4   7                        3   4   7
x             6                  x             6
          4   2   (7 x 6)       2   0   8   2
      2   4   0   (40 x 6)      2   2   4
1     8       0   0 (300 x 6)
2   0   8   2
1
```

Step six

Extend written methods to 2 digits x 2 digits and 3 digits x 2 digits, then 4 digits x 2 digits.

Start with grid method, then develop expanded recording and then move onto formal written method for long multiplication, using practical resources to support if required.

26 x 16 = 416

X	20	6
10	200	60
6	120	36

Grid method

200 + 120 + 60 + 36 = 416

To support with transition to long multiplication it has been decided to start by multiplying the smallest digit first, this is different to examples given in Abacus.

Expanded or ladder method

```
      100s  10s  1s                   100s  10s  1s
            2    6                          2    6
x           1    6            x             1    6
                 3   6  (6 x 6)       1     5    6
      1     2    0  (20 x 6)              3
            6    0  (6 x 10)      2     6    0
      2     0    0  (20 x 10)     4     1    6
      4     1    6                 1
      1
```

Long multiplication

223 x 16 = 3568

X	200	20	3
10	2000	200	30
6	1200	120	18

2000 + 1200 + 200 + 120 + 30 + 18 = 3568

```
      1000s 100s  10s  1s                  1000s 100s  10s  1s
            2     2    3                         2     2    3
x                 1    6           x                   1    6
                      1   8  ( 3 x 6)      1     3     3    8
```

	1	2	0	(20 x 6)
1	2	0	0	(200 x 6)
		3	0	(3 x10)
	2	0	0	(20 x 10)
2	0	0	0	(200 x 10)
3	5	6	8	

	1	1	
2	2	3	0
3	5	6	8

Extend use of multiplication for bigger numbers and decimals.
Estimating and checking of answers should be encouraged.

Example:

x	20	3	0.5	
10	200	30	5	235
2	40	6	1	47
				282

23.5 x 12 = (20 + 3 + 0.5) x (10 + 2)

With decimals change to whole numbers by powers of 10, then undo at end of the calculation.
For example:
23.6 x 3.4

Multiply both 23.6 and 3.4 by ten to make the calculation 236 x 34, then when calculated divide the answer by 100.
23.6 x 10= 236
3.4 x 10 = 34

x	200	30	6
30	6000	900	180
4	800	120	24

6000 + 900 + 180 + 800 + 120 + 24 = 8024

8024 ÷ 100 = 80.24

Division

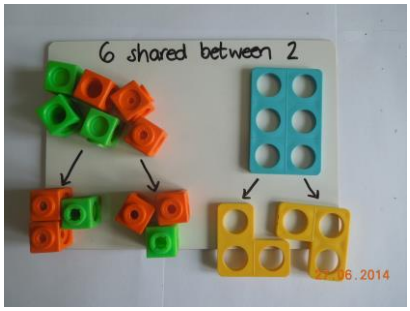
The method developed in this policy for division is the chunking method.

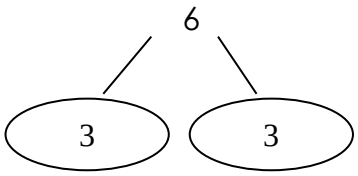
Step one

Discuss and demonstrate with the pupils sharing; "one for you one for me."

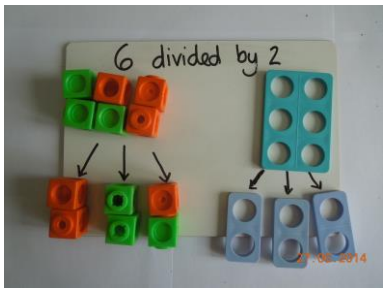
Step two

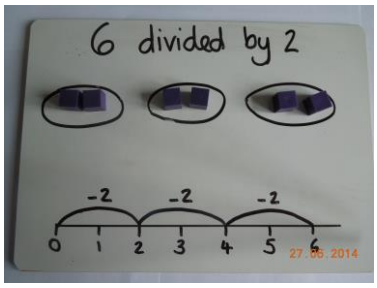
Develop division as sharing.





Develop division as repeated grouping (repeated subtraction of the same size) using practical apparatus and diagrams.





Step three

Develop an understanding of division using arrays and number lines showing repeated groups. Use number lines to show repeated grouping (repeated subtraction of sets of the same size).

○ ○ ○

2 lots of 3

○ ○ ○

Step four

Develop the use of ÷ and = symbols to record calculations horizontally. Use arrays and other practical resources to illustrate making repeated groups.

Begin to derive new facts from known facts

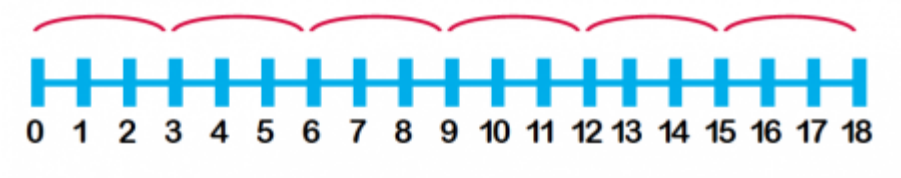
e.g. 8 ÷ 2 = 4 (known fact)

80 ÷ 2 = 40

800 ÷ 2 = 400

Begin to carry out division of two digits by one digit calculations with no remainders, then introducing remainders, using informal methods, such as number lines first.

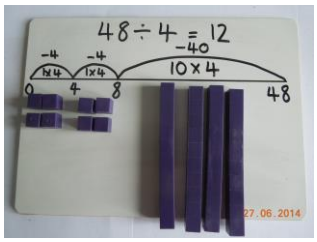
18 ÷ 3



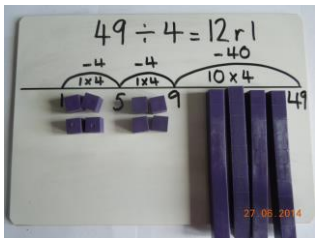
Step five

Division using larger multiples of the divisor, first with no remainder, then with remainders.

48 ÷ 4



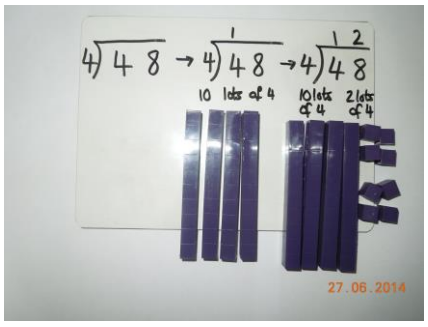
49 ÷ 4



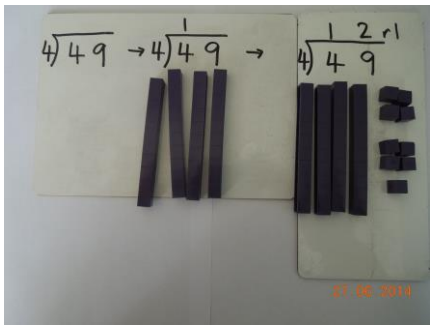
Step six

Move to develop the standard method for short division, first with no remainders, then with remainders.

48 ÷ 4



49 ÷ 4



Begin with calculations that the pupils can already do mentally. Encourage the pupils to estimate first. Use thought bubbles.
Example: 97 ÷9 = 10 r7

9⟌ 9 7
-9 0 (10 x 9)
7

Step seven

Use the expanded method, also known as chunking, with larger numbers. Use thought bubbles for jottings.
Example: 196 ÷ 6 = 32 r 4

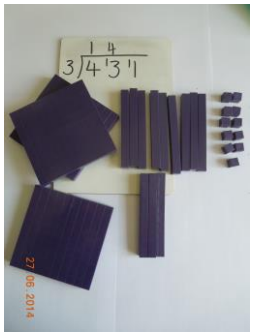
6⟌1 9 6
- 6 0 (10 x 6)
1 3 6
- 6 0 (10 x 6)

6 x 10 = 60
6 x 20 = 120
6 x 30 = 180

7 6
- 6 0 (10 x 6)
1 6
- 1 2 (2 x 6)
4

Extend use of short division methods for 3 digits divided by 1 digit calculations and 4 digits divided by 1 digit.

- No carrying forward required e.g. 448 ÷ 4 (as above but with additional hundreds column)
- No carrying forward required, but with remainders e.g. 449 ÷ 4 (as above with additional hundreds column)
- Carrying forward required e.g. 536 ÷ 4
- Carrying forward required, and with remainders e.g. 539 ÷ 4



Step eight

The chunking method can be contracted, as pupils become more secure in mental strategies. For example, 30 x 6 instead of 10 x 6 three times. Use thought bubbles to support when needed.

Example: 196 ÷ 6 = 32 r 4

3 2 r 4
6 ⟌ 1 9 6
1 8 0 (30 x 6)
1 6
- 1 2 (2 x 6)
4

Step nine

Using the formal method for long division pupils divide larger numbers and decimals.

2 8 r 12
15 ⟌ 4 3 2
- 3 0 0 (15 x 20)
1 3 2
1 2 0 (15 x 8)
1 2