Calculation Policy for Mathematics

RGS

Calculation Policy

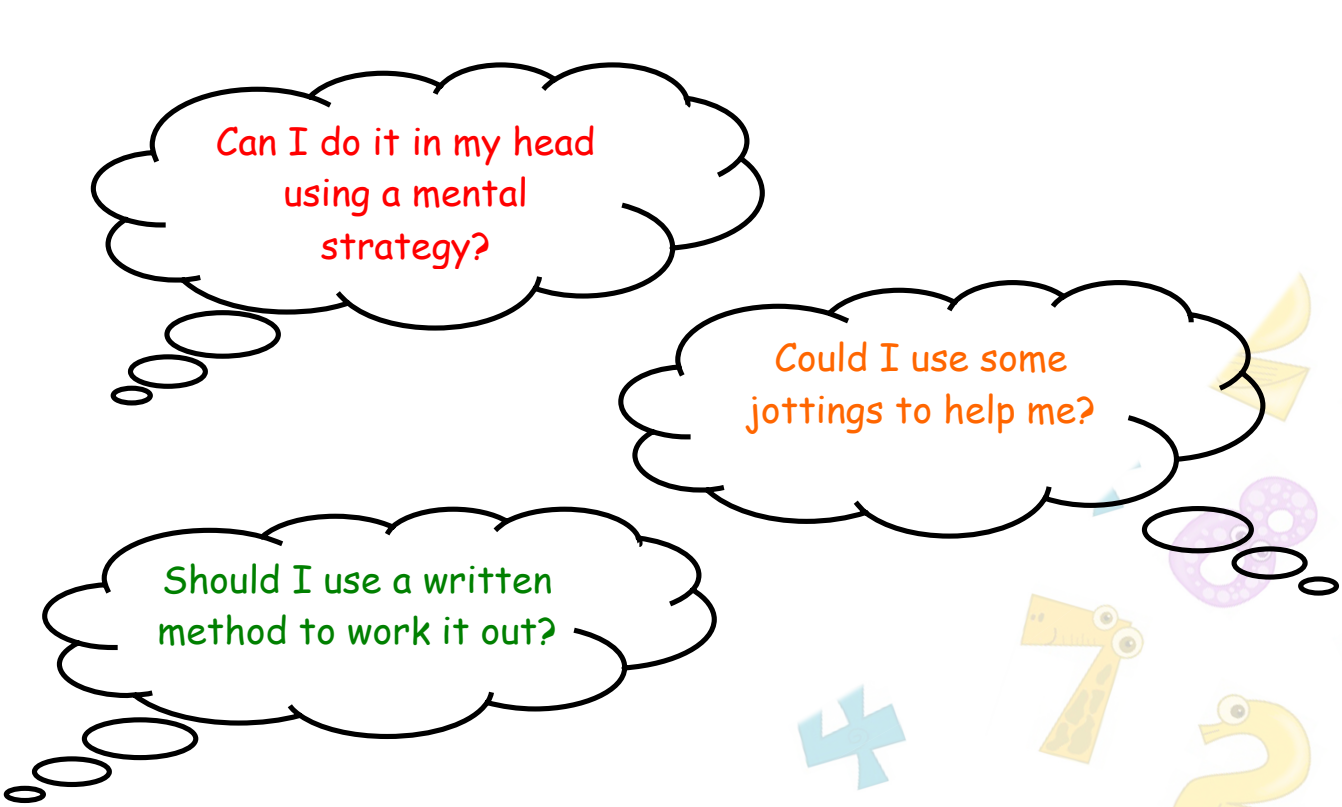
The following calculation policy has been devised to meet requirements of the National Curriculum 2014 for the teaching and learning of mathematics, and is also designed to give pupils a consistent and smooth progression of learning in calculations across the school.

Age Stage Expectations

The calculation policy is organised according to age stage expectations as set out in the National Curriculum 2014, however it is vital that pupils are taught according to the stage that they are currently working at, being moved onto the next level as soon as they are ready, or working at a lower stage until they are secure enough to move on. Some stages may simply be an explanation to help children move onto the next stage.

Choosing a calculation method:

Children need to be taught and encouraged to use the following processes in deciding what approach they will take to a calculation, to ensure they select the most appropriate method for the numbers involved:



Addition



Mental Calculations

Mental recall of number bonds

6 + 4 = 10

25 + 75 = 100

□ + 3 = 10

19 + □ = 20

Use near doubles

6 + 7 = double 6 + 1 = 13

Addition using partitioning and recombining

34 + 45 = (30 + 40) + (4 + 5) = 79

Counting on or back in repeated steps of 1, 10, 100, 1000

86 + 57 = 143 (by counting on in tens and then in ones)

460 - 300 = 160 (by counting back in hundreds)

Add the nearest multiple of 10, 100 and 1000 and adjust

24 + 19 = 24 + 20 – 1 = 43

458 + 71 = 458 + 70 + 1 = 529

Use the relationship between addition and subtraction

36 + 19 = 55

55 – 19 = 36

19 + 36 = 55

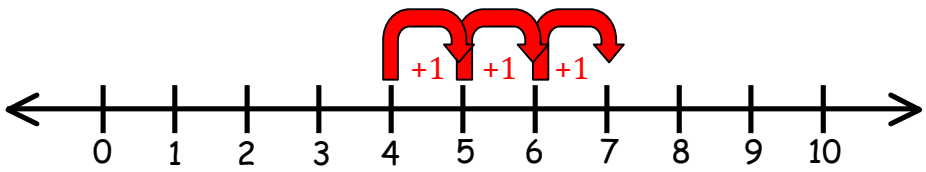
55 – 36 = 19

Addition

Stage 1 Add with numbers up to 20

Use numbered number lines to add, by counting on in ones. Encourage children to start with the larger number and count on.

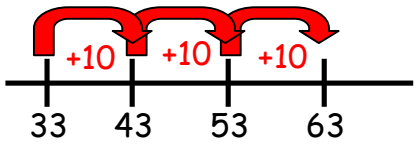
4+3=7



Stage 2 Add with 2-digit numbers

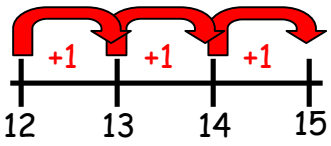
Add 2-digit numbers and tens:

33 + 30 = 63



Add 2-digit numbers and units:

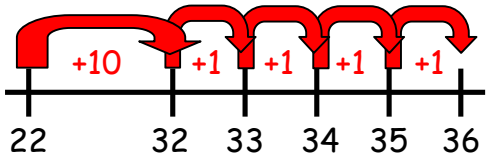
12 + 3= 15



Use empty number lines, concrete equipment, hundred squares etc. to build confidence and fluency in mental addition skills.

Add pairs of 2-digit numbers, moving to the partitioned column method when secure adding tens and units:

22+14=



STEP 1:Only provide examples that do **NOT** cross the tens boundary until they are secure with the method itself.

	2	0	+	2			
	1	0	+	4			
	3	0	+	6			
				=	3	6	

STEP 2: Once children can add a multiple of ten to a 2-digit number mentally (e.g. 80+11), they are ready for adding pairs of 2-digit numbers that DO cross the tens boundary (e.g. 38 + 23).

38+23=

	3	0	+	8			
	2	0	+	3			
	5	0	+	11			
				=	6	1	

Addition

Stage 3 Add with 3-digit numbers

Introduce the **expanded column addition** method:

	3	2	6	
+		8	3	
			9	
	1	0	0	
	3	0	0	
	4	0	9	

Add the units first, in preparation for the compact method.

In order to carry out this method:

- Children need to recognise the value of the hundreds, tens and units without recording partitioning.
- Pupils need to be able to add in columns

Stage 4 Add numbers with up to 4 digits

Move from expanded addition to the compact column method, **adding units first**, and 'carrying' numbers **underneath** the calculation. Also include money and measures contexts.

4518+292= 4810

	4	5	1	8	
+		2	9	2	
	4	8	1	0	
		1	1		

Children who are very secure and confident with 3-digit expanded column addition should be moved onto the compact column addition method, being introduced to "carrying" for the first time. Compare the expanded method to the compact column method to develop an understanding of the process and the reduced number of steps involved.

'Carry' numbers underneath bottom line.

Add **'units'** first.

Reinforce correct place value by reminding them the actual value is 5 hundreds add 2 hundreds, not 5 add 3, for example.

Addition

Stage 5 Add numbers with more than 4 digits

including money, measures and decimals with different numbers of decimal places.

	3	4	2	.	5	7	
+		4	8	.	5	7	
	3	9	1	.	1	4	
		1	1		1		

The decimal point should be aligned in the same way as the other place value columns, and must be in the same column in the answer.

Children should:

- Understand the place value of **tenths and hundredths** and use this to align numbers with different numbers of decimal places.

Stage 6 Add several numbers of increasing complexity

		4	2	.	5	7	1
			8	.	0	9	0
	+	5	9	.	6	7	0
			1	.	3	0	0
	1	1	1	.	6	3	1
		2	1		2		

Empty decimal places can be filled with zero to show the place value in each column.

Adding several numbers with different numbers of decimal places (including money and measures):

- Tenths, hundredths and thousandths should be correctly aligned, with the decimal point lined up vertically including in the answer row.
- Zeros could be added into any empty decimal places, to show there is no value to add.

Subtraction



Mental Calculations

Mental recall of addition and subtraction facts

10 – 6 = 4 17 - □ = 11

20 - 17 = 3 10 - □ = 2

Find a small difference by counting on

82 – 79 = 3

Counting on or back in repeated steps of 1, 10, 100, 1000

86 - 52 = 34 (by counting on/back in tens and then in ones)

460 - 300 = 160 (by counting on/back in hundreds)

Subtract the nearest multiple of 10, 100 and 1000 and adjust

24 - 19 = 24 - 20 + 1 = 5

458 - 71 = 458 - 70 - 1 = 387

Use the inverse relationship between addition and subtraction

36 + 19 = 55 19 + 36 = 55

55 – 19 = 36 55 – 36 = 19

Subtraction

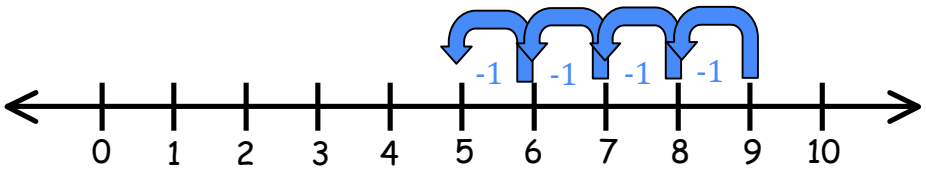
Stage 1 Subtract from numbers up to 20

Children consolidate understanding of subtraction practically, showing subtraction on bead strings, using cubes etc. and in familiar contexts, and are introduced to more formal recording using number lines as below:

Subtract by taking away

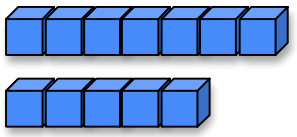
Count back in ones on a numbered number line to take away, with numbers up to 20:

9-4=5



Find the 'distance between'

This will be introduced practically with the language **'find the distance between'** and **'how many more?'** in a range of familiar contexts.



7

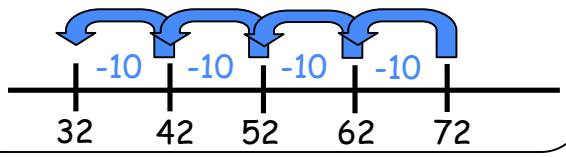
5

'Seven is 2 more than five'

Stage 2 Subtract with 2-digit numbers

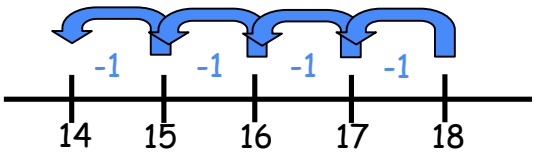
Subtract tens from 2-digit numbers:

72-40=32



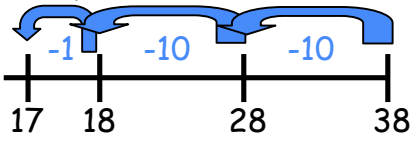
Subtract units from 2-digit numbers:

18-4=14



Subtracting pairs of 2 digit numbers on a number line:

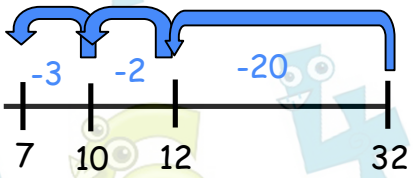
38-21=17 Partition the second number and subtract it in tens and units, as below:



Move towards more efficient jumps back, as below:



Bridging through ten can help children to become more efficient. 32-25:



Subtraction

Stage 3 Subtract with 2 & 3-digit numbers

STEP 1: introduce **partitioned column subtraction** method with examples where **no exchanging** is required.

48-33=

	4	0		8			
-	3	0		3			
	1	0	+	5			
				=	1	5	

STEP 2: Once pupils are secure with subtracting with step 1 introduce **'exchanging'**, they can use partitioned column method to subtract any 2 & 3 digit numbers.

247-153=

		2 (100)	0	0		1 4	0		7		
	-	1	0	0		5	0		3		
				0	+	9	0	+	4		

Stage 4 Subtract with up to 4-digit numbers

Compact column subtraction

	5 (4)	5	1	8
-	3	3	9	2
	2	1	2	6

To introduce the compact method, ask children to perform a subtraction calculation with the familiar partitioned column subtraction then display the compact version for the calculation they have done. Ask pupils to consider how it relates to the method they know, what is similar and what is different, to develop an understanding of it.

Children who are still not secure with number facts and place value will need to remain on the partitioned column method until ready for the compact method.

Subtraction

Stage 5 Subtract with at least 4-digit numbers

Including money, measures, and decimals.

Subtract with decimal values, including mixtures of integers and decimals, aligning the decimal point.

		$^{7}\cancel{8}$	$^{11}\cancel{2}$	$^{1}6$	$^{8}\cancel{9}$	.	$^{1}0$	
	−		4	7	3	.	6	
		7	6	9	5	.	4	

Stage 6 Subtracting with increasingly large and more complex numbers and decimal values.

		$^{1}\cancel{2}$	$^{1}6$	$^{8}\cancel{9}$	.	$^{9}\cancel{0}$	$^{1}1$	8
	−		7	3	.	6	7	0
		1	9	5	.	3	4	8

Add a 'zero' in any empty decimal places to aid understanding of what to subtract in that column.

Using the compact column method to subtract money and measures, including decimals with different numbers of decimal places.

Multiplication



Mental Calculations

Doubling and halving
Applying the knowledge of doubles and halves to known facts.
e.g. 8 x 4 is double 4 x 4

Using multiplication facts

Tables should be taught from Y2 onwards.

Year 2	2 times table 5 times table 10 times table	
Year 3	3 times table 4 times table 8 times table	**Year 4, 5 & 6** Derive and recall all multiplication and division facts up to 12 x 12

Using and applying division facts
Children should be able to utilise their tables knowledge to derive other facts.
e.g. If I know 3 x 7 = 21, what else do I know?
30 x 7 = 210, 300 x 7 = 2100, 3000 x 7 = 21 000, 0.3 x 7 = 2.1 etc
□ x 7 = 21 300 x △ = 2100 □ x O = 2.1

Use closely related facts already known
13 x 11 = (13 x 10) + (13 x 1)
= 130 + 13
= 143

Multiplying by 10 or 100
Knowing that the effect of multiplying by 10 is a shift in the digits one place to the left.
Knowing that the effect of multiplying by 100 is a shift in the digits two places to the left.

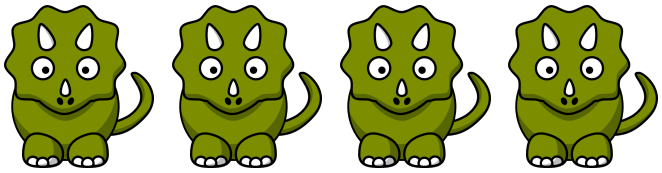
Partitioning
23 x 4 = (20 x 4) + (3 x 4)
= 80 + 12
= 102

Use of factors
8 x 12 = 8 x 4 x 3

Multiplication

Stage 1 Multiply with concrete objects, arrays and pictorial representations.

How many legs will 4 dinosaurs have?

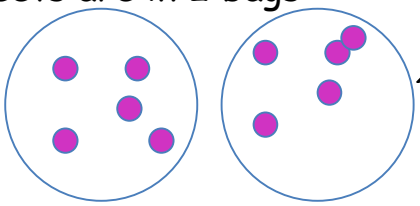


2 + 2 + 2 + 2 = 8

Give children experience of counting equal groups of objects in 2s, 5s and 10s.

There are 5 sweets in one bag.
How many sweets are in 2 bags altogether?

5+5=10



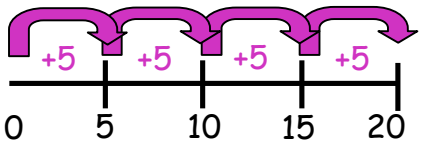
Present practical problem solving activities involving counting equal sets or groups.

Stage 2 Multiply using arrays and repeated addition.

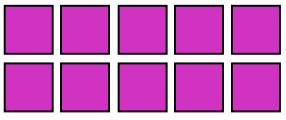
Use repeated addition on a number line:

Starting from zero, make equal jumps up on a number line to work out multiplication facts.

4x5=20



Use arrays:



5 x 2 = 10

2 x 5 = 10

5 x 2 = 2 + 2 + 2 + 2 + 2 = 10

2 x 5 = 5 + 5 = 10

Use arrays to help teach children to understand the commutative law of multiplication,

Multiplication

Stage 3 Multiply 2-digits by a single digit.

Introduce the **grid method** for multiplying 2-digit by single-digits:

34 x 9 = 306

x	30	4
9	270	36

270+36=306

Introduce the grid method with children physically making an array to represent the calculation, and then translate this to grid method format.

Stage 4 Multiply 2 and 3-digits by a single digit.

144 x 4 = 576

x	100	40	4
4	400	160	16

Encourage column addition to add accurately.

	4	0	0	
	1	6	0	
+		1	6	
	5	7	6	

Move onto short multiplication (see next stage) if and when children are confident and accurate multiplying 2 and 3-digit numbers by a single digit this way, and are already confident in 'carrying' for written addition.

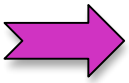
Multiplication

Stage 5 Multiply up to 4-digits by 1 or 2 digits.

Introduce column multiplication

Short multiplication for multiplying by a single digit

x	100	40	4
4	400	160	16

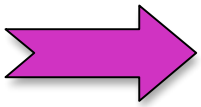


	1	4	4	
x			4	
	5	7	6	
	1	1		

Pupils could be asked to work out a given calculation using the grid, and then compare it to 'your' column method. What are the similarities and differences? Unpick and show how it reduces the steps.

Introduce **long multiplication for multiplying by 2 digits**

	10	7
10	100	70
4	40	28



		1	7	
x		1	4	
		6_2	8	
	1	7	0	
	2	3	8	
	1			

17 x 4 on the first row

(7x4=28, carrying the 2 for twenty, then 1 x 4)

17 x 10 on the 2nd row. Always remember to put a zero in units first, and then say 7 x 1, and 1 x 1.

Multiplication

Stage 6

Short and long multiplication as in step 5, and multiply decimals with up to 2d.p by a single digit.

3.19x8=15.95

	3	.	1	9
x	5			
1	5	.	9	5
			4	

Line up the decimal points in the question and the answer.

Remind children that the single digit belongs in the units column.

This works well for multiplying money (£.p) and other measures.

Division



Mental Calculations

Doubling and halving
Knowing that halving is dividing by 2

Deriving and recalling division facts

Tables should be taught every day and used to derive division facts.

Year 3	3 times table 4 times table 8 times table	**Year 4, 5 & 6** Derive and recall all multiplication and division facts up to 12 x 12

Using and applying division facts

Children should be able to utilise their tables knowledge to derive other facts.
E.g. If I know 3 x 7 = 21, what else do I know?

30 x 7 = 210, 300 x 7 = 2100, 3000 x 7 = 21 000, 0.3 x 7 = 2.1 etc

□ ÷ 2 = 4 80 ÷ △ = 40 □ ÷ △ = 40

Dividing by 10 or 100

Knowing that the effect of dividing by 10 is a shift in the digits one place to the right.
Knowing that the effect of dividing by 100 is a shift in the digits two places to the right.

Use of factors

72 ÷ 18 → 72 ÷ **6** = 12 → 12 ÷ **3** = 4 → 72÷18=4
(6 and 3 are factors of 18)

Use related facts

Given that 1.4 x 1.1 = 1.54
What is 1.54 ÷ 1.4, or 1.54 ÷ 1.1?

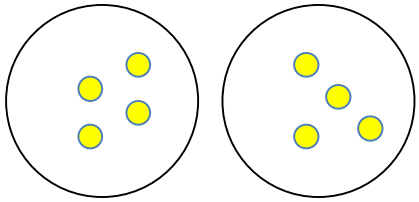
Division

Stage 1 Group and share small quantities.

Using objects, diagrams and pictorial representations to solve problems involving **both grouping and sharing.**

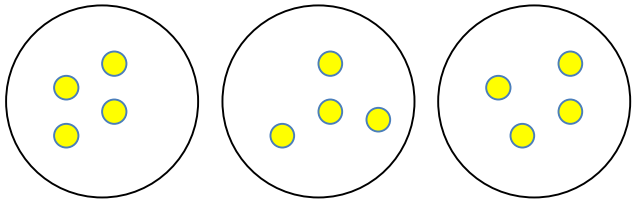
How many groups of 4 can be made with 8 stars? 2

Grouping:



12 shared between 3 is 4

Sharing:



4 4 4

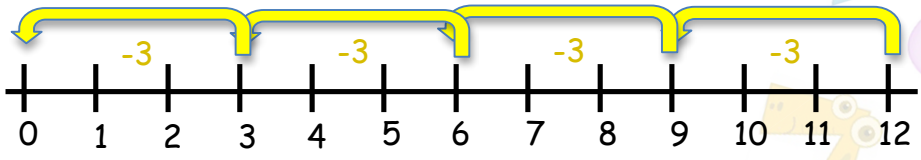
Stage 2 Divide 2-digit numbers by a single digit.

Using objects, diagrams and pictorial representations and sharing on a number line.

Repeated subtraction

Once children are secure with sharing and grouping move onto repeated subtraction on a number line.

12÷3=4

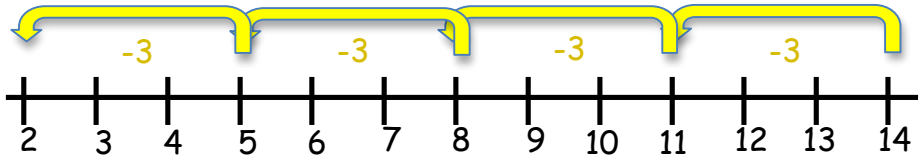


Division

Stage 3 Divide 2-digit numbers by a single digit.

Repeated subtraction:

14÷3=4r2



STEP 1: **Children continue to work out unknown division facts by subtracting on a number line.** They are also now taught the concept of **remainders,** as in the example. This should be introduced practically and with arrays, as well as being translated to a number line. Children should work towards calculating some basic division facts with remainders mentally for the 2s, 3s, 4s, 5s, 8s and 10s, ready for 'carrying' remainders across within the short division method.

Short Division: Limit numbers to NO remainders in the answer OR carried (each digit must be a multiple of the divisor)

	3	2	
3	9	6	

STEP 2: Once children are secure with division as sharing and demonstrate this using number lines, arrays etc., short division for larger 2-digit numbers should be introduced, initially with carefully selected examples requiring no calculating of remainders at all.

Short Division: Limit numbers to NO remainders in the final answer, but with remainders occurring within the calculation.

	1	8	
4	7	$^{3}2$	

STEP 3: Once children demonstrate a full understanding of remainders, and also the short division taught, they can be taught how to use the method when remainders occur within the calculation (e.g. 72÷4), and be taught to 'carry' the remainder onto the next digit.

Division

Stage 4 Divide up to 3-digit numbers by a single digit.

Continue to develop short division:

	2	1	8
4	8	7	$^{3}2$

Pupils move onto dividing numbers with up to 3-digits by a single digit, however problems and calculations provided should **not result in a final answer with remainder** at this stage. Children who exceed this expectation may progress to stage 5.

Stage 5 Divide up to 4 digits by a single digit.

(Including those **with remainders**)

	0	6	6	3	r5
8	5	$^{5}3$	$^{5}0$	$^{2}9$	

The answer to 5309 ÷ 8 could be expressed as **663 and five eighths, 663 r 5**, as a **decimal**, or **rounded** as appropriate to the problem involved.

Short division with remainders: Now that pupils are introduced to examples that give rise to remainder answers, division needs to have a real life problem solving context, where pupils consider the meaning of the remainder and how to express it, i.e. As a fraction, a decimal, or as a rounded number or value, depending upon the context of the problem.

Division

Stage 6 Divide at least 4 digits by both single-digit and 2-digit numbers.

Short division, for dividing by a single digit:

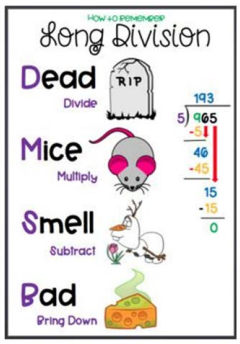
	0	8	1	2	.	1	2	5
8	6	$^{6}4$	9	$^{1}7$	.	$^{1}0$	$^{2}0$	$^{4}0$

Calculating a **decimal remainder**: In this example, rather than expressing the remainder as r 1, a decimal point is added after the units because there is still a remainder, and the one remainder is carried onto zeros after the decimal point (to show there was no decimal value in the original number). Keep dividing to an appropriate degree of accuracy for the problem being solved.

Introduce **long division by** dividing by 2 digits.

			2	7
3	6	9	7	2
		7	2	0
		$^{1}2$	$^{1}5$	2
		1	8	0
			7	2
			7	2
				0

Answer: 27



Teach pupils to write a '**useful list**' first at the side.

Useful list:

1x = 36
5x = 180
10x = 360
100x = 3600

Using the 'Dead Mice Smell Bad' mnemonic, introduce the concept of dividing by the divisor then multiplying the number on the top line and setting it out like a formal column subtraction. Next, using the remainder, bring down the next digit in the dividend. Repeat the process to answer or to two decimal places if needed.