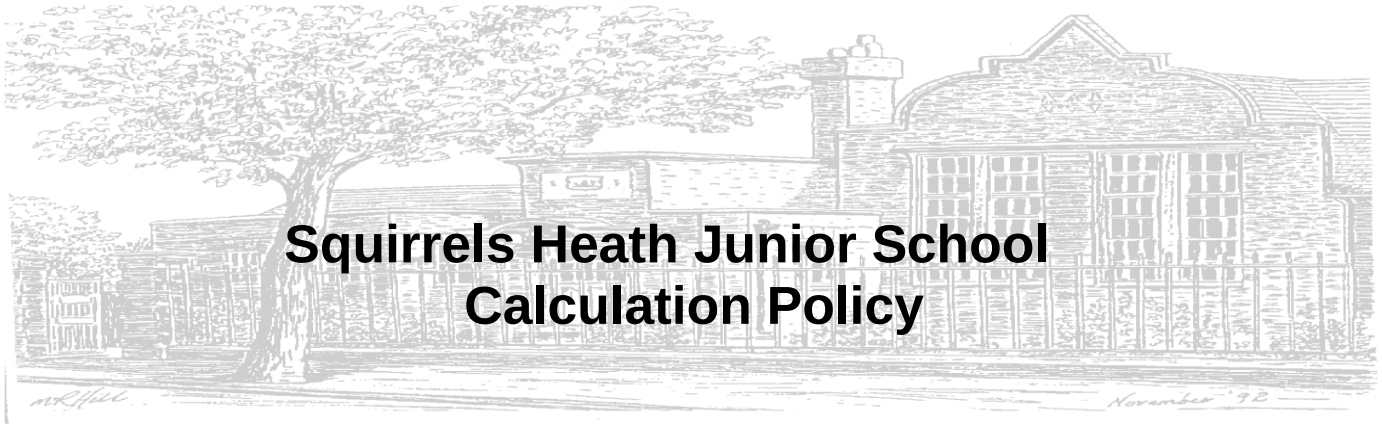
Calculation Policy

Adoption by Governing Body

…… (Signature of Chair of Governors)

……January 2019……. (Date)

To Be Revised ……January 2020……..(Date)



Squirrels Heath Junior School
Calculation Policy

Introduction

In September 2014 the Government updated the National Curriculum. This adaptation raised the expectations for each year group and has put a high focus on times table knowledge and formal written methods. This policy will outline the different methods that will be used throughout the school. Even though these are the recommended strategies for each year group, a range of options will still be taught. Therefore, this will mean that during lessons, it would be expected to see the students use a range of strategies.

Our aims are simple:

1) Provide children with consistently good and outstanding teaching.
2) Enable children of all abilities to achieve well and make good and better progress.
3) To ensure children's learning of calculation, both mental and written, is scaffolded and progressive.
4) To ensure children have a secure understanding and knowledge of key arithmetic facts and methods, to enable them to apply their learning in a wide variety of ways.

It is vital that children understand the methods they are using. They should be provided opportunities to use appropriate resources at all stages of learning calculation methods. Children should use practical resources, including but not limited to:

- Numberlines
- Numbersquares
- Numicon
- Base ten
- Unifix / mulitlink cubes
- Money
- Counters

Children should also simultaneously practice different methods to complete the same calculation to secure their knowledge, and support their learning through understanding. This ensures children are ready for the next stage of their learning in calculation. Children should learn how different types of calculation are more efficient for differing types of numbers and problems, and should learn to identify what type of calculation is most efficient for individual problems. Children should never be taught 'tricks.'

Calculation should be taught discretely, and embedded in contextualised problems. Children must also be provided with many opportunities to embed and deepen their calculation knowledge through application, reasoning and problem solving opportunities.

Procedures for review and evaluation

Our calculation policy is a living policy. It is monitored, reviewed and evaluated annually.

Last reviewed – January 2019

Mental Addition Methods

It is vital that children are secure in their mental addition. By the end of Year 2, all children should be able to mentally add:

- Any three 1 digit numbers in their heads (eg. 8+5+9)
- Any two 2 digit numbers in their heads (eg. 67+25)

Children with strong recall of addition facts are in a stronger position to use them quickly when learning formal written methods.

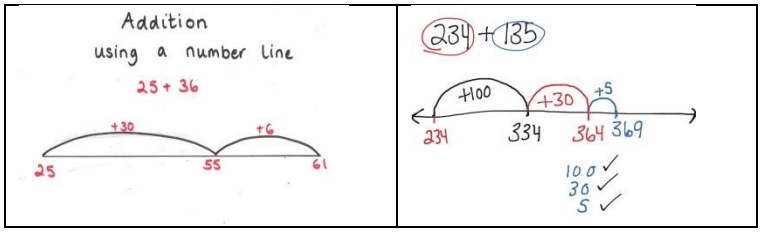
Numbersquares:

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Example: 38+24
Step 1: Put your finger on the larger number (38).
Step 2: Count on 20. (Once children are secure, they should learn to jump down 2 to add 20)
Step 3: Count on 4, remember to move onto the next row as needed.

This method helps children practise mental addition, leading to the ability to complete the entire sum mentally.

Numberlines:

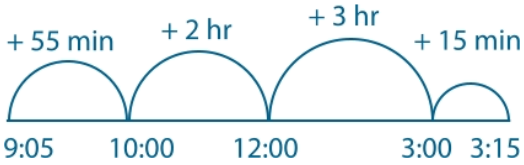


Step 1: Write down the larger number.
Step 2: Partition the second numbers into HTO.
Step 3: Add the Hundreds, then the Tens, then the Ones.

This method helps children practise mental addition, leading to the ability to complete the entire sum mentally.

Numberlines (ctd):

This method is also important for other curriculum areas, for example calculating durations of time, where column addition is not suitable.



This method allows children to calculate how much time has passed from 9:05 to 3:15 (6 hours, 10 minutes).

Partitioning and jottings:

Children may partition numbers and make notes to support their mental calculations.

368 + 74
300 + 60 + 8 + 70 + 4
300+ 130 +12
430 + 12
442
Answer: 368 + 74 = 442

Alternatively, they may use the following format:

368 + 74
368+ 70 = 438
438 + 4 = 442

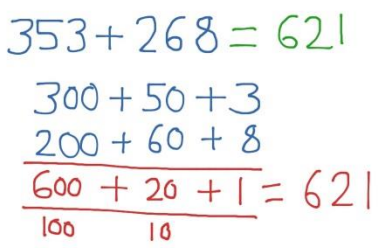
Answer: 368 + 74 = 442

This skill can then be applied to other larger amounts.

Formal Written Addition Methods

By the end of year three, all children should be able to use the formal method of the columnar strategy to solve addition sums. In order for the place value knowledge to become secure, year three will use an expanded version of columnar addition. It is of great importance that the children understand the value of each digit in a number, which is why this method will be taught first.

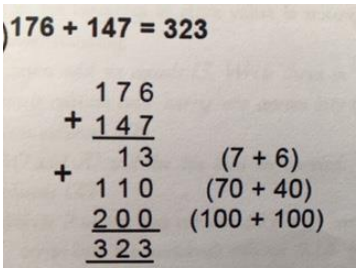
The expanded partitioning method 1:



Step 1: Partition each number into Hundreds, Tens and Ones.
Step 2: Ensure numbers are aligned (in the correct column).
Step 3: Add the Ones, then the Tens, then the Hundreds – always start with the smallest digits.
Step 4: Recombine (add the numbers back together)

This method ensures children secure their understanding of place value, so that they are clear what each digit represents. This means they understand that the 3 represents 3 tens.

The expanded partitioning method 2:

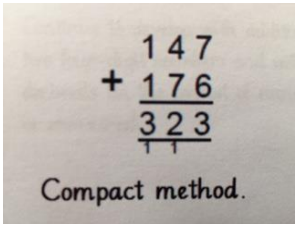


Step 1: Start by adding the ones together.
Step 2: Then add the tens together.
Step 3: Finally, add the hundreds together.
Step 4: Then add together each column.

It is important to use the brackets to show which numbers the child are adding together. This ensures that they continue to understand the place value of each digit and that they do not see all the digits as ones

Once the children are comfortable with the method above, the method can be condensed. However, they must be very secure on their place value understanding before moving onto the next stage.

The Compact Formal Written Method:



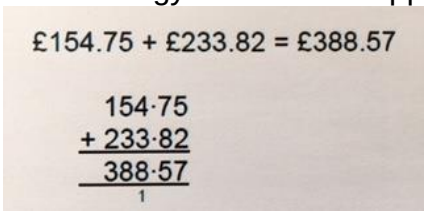
This method is very straightforward until the children must carry.

Step 1: Add the Ones (7+6). As this leads to a two digit number (13), the 3 is written in the Ones column and the ten is carried over into the Tens column.

Step 2: Add the Tens, remembering to include any carried tens (40+70+10)

Step 3: Add the Hundreds, remembering to include any carried hundreds (100+100+100).

This strategy can then be applied to larger numbers and decimal numbers.



How to avoid potential struggles with addition:

1. Children must ensure their digits are written correctly and neatly, so that they do not look like other numbers (eg if 1 looks like 7, or 6 looks like 0, children will not calculate correctly)
2. Children must line the digits up in the correct columns (aligning), particularly when numbers are different sizes (eg. 578 + 49).
3. Children must always start adding from the smallest values (the Ones column for whole numbers)
4. Children must check carefully, as digits will not always be carried.
5. Children sometimes carry the incorrect digit (eg they carry the 3 instead of the 1) – the number should be read from left to right to check.
6. As children add more than 2 numbers at a time, they must recognise that they may carry digits other than 1.

Mental Subtraction Methods

It is vital that children are secure in their mental subtraction. By the end of Year 2, all children should be able to mentally subtract:

- Any three 1 digit numbers in their heads (eg. 9-2-4)
- Any two 2 digit numbers in their heads (eg. 64- 29)

Children with strong recall of subtraction facts are in a stronger position to use them quickly when learning formal written methods.

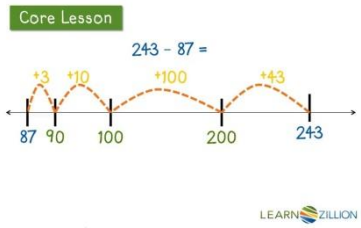
Numbersquares:

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Example: 72 - 38
Step 1: Put your finger on the larger number (72).
Step 2: Count back 30. (Once children are secure, they should learn to jump up 3 to subtract 30)
Step 3: Count back 8, remember to move back to the previous row as needed.

This method helps children practise mental subtraction, leading to the ability to complete the entire calculation mentally.

Numberlines:



Many children use addition to find the difference between numbers.

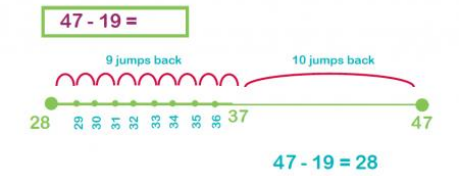
Eg. 243 – 87

Step 1: Write down the smaller number (87).
Step 2: Count on to the next Ten (90)
Step 3: Count on to the next Hundred (100)
Step 4: Count on to the final hundred as needed (200)
Step 5: Count on to the starting number (243)

Step 6: Add together all the jumps to find the answer (156).

This method helps children practise mental addition, leading to the ability to complete the entire sum mentally.

Children may use counting back using a numberline:



47 - 19 = 28

Step 1: Write the starting number (47) on the right hand side.
Step 2: Take away the tens.
Step 3: Take away the ones.
This method can also be used for larger numbers.

This method is also important for other curriculum areas, for example calculating durations of time, where column addition is not suitable.

Partitioning, notes and jottings:

Children may partition numbers and make notes to support their mental calculations.

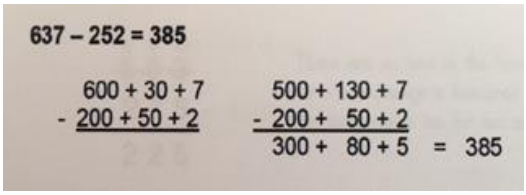
368 - 74
368 - 70 = 298
298 - 4 = 294
Answer: 368 - 74 = 294

This skill can then be applied to other larger amounts.

Formal Written Subtraction Methods

By the end of year three, all children should be able to use the formal method of the columnar strategy to solve subtraction calculations. In order for the place value knowledge to become secure, year three will use an expanded version of columnar subtraction. It is of great importance that the children understand the value of each digit in a number, which is why this method will be taught first.

The expanded partitioning method 1:



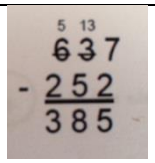
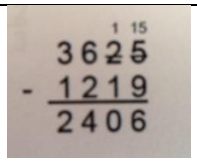
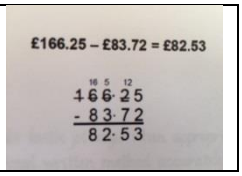
The expanded partitioning method 2:

92
- 41
1 (2 – 1 = 1)
50 (90 – 40 = 50)
51

Step 1: Start by taking away the ones.
Step 2: Then take away the tens.
Step 3: Finally, take away the hundreds.
Step 4: Then, join the steps together. (50 + 1 = 51)
It is important to use the brackets to show which numbers the child are taking away, to ensure that they understand the place value of each digit and that they do not see all the digits as ones.

Once the children are comfortable with the method above, the method can be condensed. However, they must be solid on their place value understanding before moving onto this stage.

The Compact Formal Written Method:

679 − 142 537			

Step 1: Subtract the ones eg 9 – 2 = 7 ones
Step 2: Subtract the tens eg. 7 (tens) - 4 (tens) = 3 tens
Step 3: Subtract the eg. 6 (hundreds) - 1 (hundred) = 5 hundreds

With exchanging:
Step 1: Subtract the ones (7-2 = 5)
Step 2: Subtract the tens (3 tens - 5 tens = which cannot be done).
Therefore, you need to exchange. You take a hundred, which is the same as 10 tens.
So, the 3 tens turns to 13 tens (13 tens – 5 tens = 8 tens)
But, the hundred turns from 6 hundreds to 5 hundred as I have exchanged 100 into 10 tens which is shown with the little 5 above the 6.
Step 3: Subtract the hundreds column (5 hundreds – 2 hundreds = 3 hundreds).

This strategy can then be applied to larger numbers and decimal numbers.

How to avoid potential struggles with subtraction:

1. Children must ensure their digits are written correctly and neatly, so that they do not look like other numbers (eg if 1 looks like 7, or 6 looks like 0, children will not calculate correctly)
2. Children must line the digits up in the correct columns (aligning), particularly when numbers are different sizes (eg. 578 - 49).
3. Children must always start subtracting from the smallest amount (the Ones column for whole numbers)
4. Children must always start with the number on the top, to ensure they do not just take the smalller number away.
5. Children must ensure the take one away from the next column when they exchange.
6. Children must be extra careful when numbers involve zero, particularly during exchange.
7. Children must consider whether column subtraction is the most efficient method, especially when there are multiple zeros eg. £10,000 - £5,689.45 (here, counting on mentally using a numberline may be more efficient).

Mental Multiplication Methods

It is vital that children are secure in their mental multiplication skills. By the end of Year 2, all children should:

- Know multiplication facts for the x2, x5, x10 tables.
- Be able to double any number up to, and including, 50

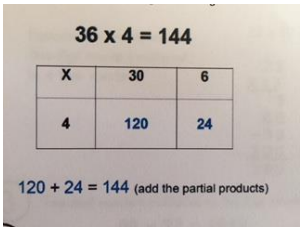
By the end of Year 3, children must know their multiplication facts for the x2, x3, x4, x5, x8 and x10 tables by heart.

In Year 4, children must know their multiplication facts for all times tables up to 12x12 by heart. They must also know related facts:
4 x 7 = 28
7 x 4 = 28
28 ÷ 4 = 7
28 ÷ 7 = 4

Children with strong recall of multiplication facts are in a stronger position to use them quickly when learning formal written methods.

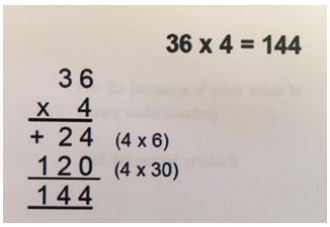
Formal Written Multiplication Methods

Stage 1: Grid Method

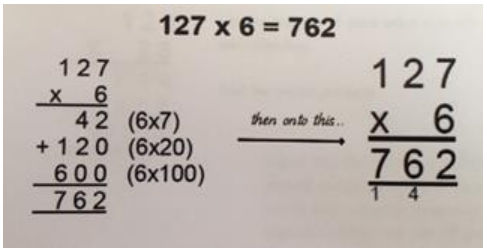


Step 1: Partition the 2 (or 3) digit number (36 = 30+6)
Step 2: Multiply each part by the second number
Step 3: Add the totals together

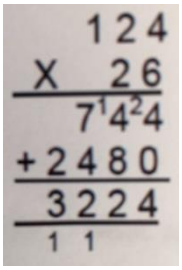
Stage 2: Expanded Vertical Multiplication:



Stage 2: Compact Vertical Multiplication:



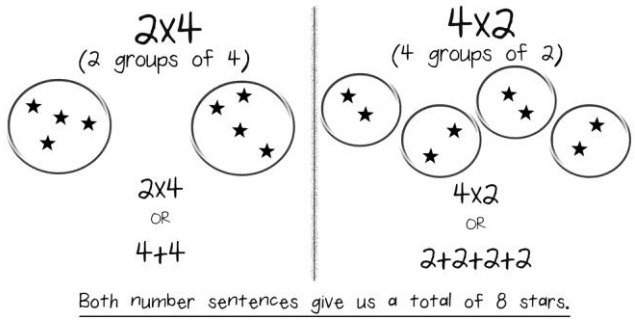
This can them by extended for 2 digit number calculations:



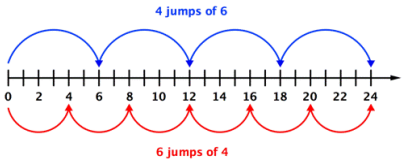
Other Multiplication Methods

1) Arrays

Arrays help children to secure their understanding of multiplication as repeated addition:



2) Numberlines



Once children understand the concept through using arrays, they can use numberlines to count on in jumps .

How to avoid potential struggles with multiplication:

1. Children must know their times tables!
2. Children must remember to carry the correct digit.
3. Children must take care multiplying tens and hundreds
4. Children must ensure that if there are no more numbers to multiply, the carried digit must be included in the answer:

Mental Division Recall

It is vital that children are secure in their mental division skills. By the end of Year 2, all children should be able to:

- Instantly recall division facts for the x2, x5, x10 tables (eg 24 divided by 2).
- Halve any even number up to, and including, 100
- Calculate half of odd numbers up to 100, expressing the remainder as a fraction

By the end of Year 3, children must know their division facts for the x2, x3, x4, x5, x8 and x10 tables by heart.

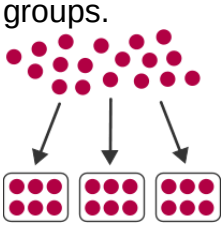
By the end of Year 4, children must know their division facts for all times tables up to 12x12 by heart. They must also know related facts for multiples of 10 and 100.
Eg. 270 ÷ 9 = 30 (using the knowledge that 27 ÷ 9 = 3)

Children with strong recall of division facts are in a stronger position to use them quickly when learning formal written methods.

Mental Division Methods

1) Grouping Physical Resources

Children use physical resources to secure their understanding of division as sharing into equal groups.



For 18 ÷ 3, children share out 18 cubes or other physical apparatus into 3 equal groups and count how many in each.

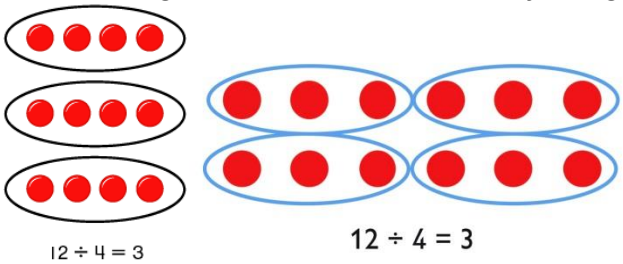
They also organise the cubes into groups of 3, and count how many groups they make.

This supports children to secure the concept of making equal groups and sharing equally.

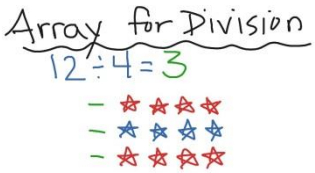
2) Arrays

Arrays help children to secure their understanding of division as grouping and sharing.

Children organise resources into arrays to group and share equally in an organised fashion.

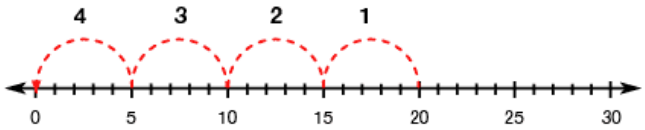


They can then begin to use written marks to represent arrays.



3) Numberlines

Once children understand the concept through using physical apparatus and pictoral representations through arrays, they can use numberlines to count back in jumps.



20 ÷ 5 = 4
Children start at 20, and count back in groups of 5 until they get to zero. Then they count how many groups of 5 they counted back.

Children also learn to recognise that they are subtracting these groups until they reach zero.

This method supports children's learning that division is repeated subtraction.

Formal Written Division Methods

Stage 1: Chunking
This stage is essential to help children grasp the concept that division is repeated subtraction. This ensures that as they move on to quicker methods, they understand what each digit represents.

Children spend time practising physically taking away cubes and other physical resoures to secure the concept, before writing down the method.

92 ÷ 4 (How many groups of 4 can you take away from 92?)

```
4 | 92
  – 40   (10 x 4)
    52
  – 40   (10 x 4)
    12
  – 12   (3 x 4)
    00
```

10 + 10 + 3 = 23
Answer = 23

Step 1: Organise your numbers as shown.
Step 2: Think of the easiest but highest jump that can be done. In this case that is 10 groups of 4. This can then be taken away.
Step 3: What is the next easiest but highest jump that can be done? In this case, it is 10 groups of 4 again. Then, take that away.
Step 4: There are 3 groups of 4 left so this is taken away and leaves 0.
Step 4: The groups of 4, in the circle, are counted and that is the answer.
Step 5: If on other occasions there are any left over this becomes a remainder.

Stage 1: Chunking (ctd)

As children become more proficient, and when they know their tables, they can make bigger groups at a time.

932 ÷ 5 (How many groups of 5 can you take away from 935?)

932	
– 500	(100 x 5)
432	
– 200	(40 x 5)
232	
– 200	(40 x 5)
32	
30	(6 x 5)
2	

Answer = 186 r.2

Stage 2: Bus Stop Method (short division)

Knowing the times tables is essential for this method.

A) No carrying

$$2\overline{)86}\quad 43$$

Step 1: How many 2s go into the first digit (8) and put that number above it.
Step 2: How many 2s go into the second digit (6) and put that number above it.
Step 3: The number on top is the answer.

B) Carrying

362 ÷ 7 =

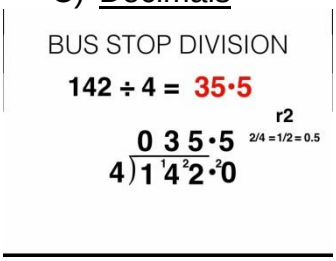
```
      5 1 r5
   ┌──────
7  │3 6 ¹2
```

362 ÷ 7 = 51 r5

Step 1: How many 7s go into the first digit (3)?
If it cannot be divided exactly, any leftover must be carried to the next number.
If the number cannot go into it, the entire digit must be carried over.
Step 2: How many 7s go into the second digit (36)? Put that number above it and carry over any remainder (1).
Step 3: How many 7s go into the final digit (12)? Put that number above it and carry over any remainder (5).
Step 4: The number on top is the answer.

Children should be able to represent the remainder, both as a simple remainder (r.5) and as a fraction (5/7).

C) Decimals



Knowing the tables is essential for this method.

Step 1: Follow the steps for B.
Step 2: After dividing the Ones column, add a decimal point and a place holder (as 2 is the same as 2.0)
Step 3: Carry into the tenths column and continue the method.

This method is used for money, and for questions where the answer must be rounded to 1 or 2 decimal places.

Stage 3: Bus Stop Method (for larger divisors)

Knowing the tables is essential for this method.

547 ÷ 23 =

```
      2 3 r18
   ┌──────
23 │5 4 8 7
```

23
46
69
92

547 ÷ 23 = 23 r18

Step 1: Write out the relevant times tables to the side of your work.
Step 2: Divide the first digit by 23 (5 ÷ 23). This cannot be done so the 5 is carried to the next column.
Step 3: Divide the second digit by 23 (54 ÷ 23). This can be divided twice, so 2 is put on top, and 8 carried over to the next column.
Step 4: Divide the third digit by 23 (87 ÷ 23). Look at the tables and see which number gets you closest. In this case, it is 69 and there are 18 left over. The 3 is written on top of the bus stop and the 18 is carried and becomes the remainder.

How to avoid potential struggles with division:

1. Children must understand that division is repeated subtraction.
2. Children must know their times tables and related division facts by heart.
3. Children must remember to carry, and carry the correct amount into the next column over. For this, they must have secure recall of subtraction facts to 100.
4. When children apply the bus stop method to decimals, they must remember to align the decimal point.