Multiplicative Reasoning

This document is part of a set that forms the subject knowledge content audit for Key Stage 1 and Key Stage 2 maths. Each document contains: audit questions with tick boxes that you can select to show how confident you are (1 = not at all confident, 2 = not very confident, 3 = fairly confident, 4 = very confident), exemplifications; explanations; and further support links. At the end of each document, there is space to type notes to capture your learning and implications for practice. The document can then be saved for your records.

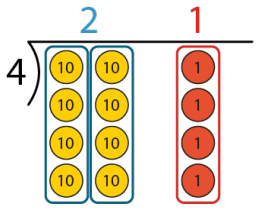
Question 8

How confident are you that you understand and can support children to explore different algorithms for division?

1 ☑ 2 ☐ 3 ☐ 4 ☐

How would you respond …?

a. Why are the place value counters circled? What do they represent?



b. What role does a ratio chart play in division?

	× 31
1	31
2	62
3	
4	124
5	155
6	
7	
8	248
9	
10	310

c. Use three different written strategies to solve the problem.

Becky has 434cm of ribbon to wrap up prizes for a school competition. Each prize needs 31cm of ribbon. How many prizes can she wrap?'

Responses

Note your responses to the questions here before you engage with the rest of this section:

Did you notice that…?

a. In this representation of short division, the place value counters are circled to show the groups of four. The quotitive structure means that the dividend (total quantity) is grouped using the divisor (size of the groups). The eight tens are grouped into fours. Each group is shown by a circle around the place value counters. There are two groups of four tens and one group of four ones.

b. A ratio chart can be used to support children when they are dividing by two-digit numbers. They can apply multiplication facts and strategies to division, such as doubling and halving for calculating multiples of the divisor. Making a ratio chart before the division calculation should make the calculation more fluent as it can be used as a reference point.

Ratio chart

	× 33
1	33
2	66
3	
4	132

Short division

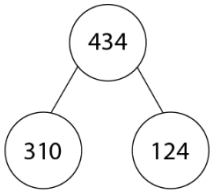
$$33\overline{)7\ {}^{7}1\ {}^{5}8} \quad 0\ 2\ 1\ \text{r}\ 25$$

Long division

$$\begin{array}{r} 2\ 1\ \text{r}\ 25 \\ 33\overline{)7\ 1\ 8} \\ 6\ 6 \\ \hline 5\ 8 \\ 3\ 3 \\ \hline 2\ 5 \end{array}$$

c. These are three possible strategies.

Partitioning



310	÷	31	=	10
124	÷	31	=	4
434	÷	31	=	14

Short division

$$31\overline{)4\ {}^{4}3\ {}^{12}4} \quad 0\ 1\ 4$$

Long division

$$\begin{array}{r} 0\ 1\ 4 \\ 31\overline{)4\ 3\ 4} \\ 3\ 1 \\ \hline 1\ 2\ 4 \\ 1\ 2\ 4 \\ \hline 0 \end{array}$$

(1 ten × 31 = 31 tens)

(4 ones × 31 = 124 ones)

Developing division

In this section, different written algorithms for division will be explored, with a focus on partitioning and short division. Children should be secure in their multiplication facts for fluent division calculation.

Children will start by using informal written methods and unitising language, initially supported by the use of base-ten equipment, to divide two-digit dividends by single-digit divisors, where each digit of the dividend is a multiple of the divisor.

84 ÷ 4 = ?

8 tens ÷ 4 = 2 tens	8 tens	÷	4	=	2 tens
4 ones ÷ 4 = 1 one	4 ones	÷	4	=	1 one
	84				21

When children are confident using partitioning to calculate, they can extend the use of informal written methods to understand when to exchange tens for ones for cases *without* an overall remainder.

72 ÷ 3 = ?

7 tens ÷ 3 = 2 tens r 1 ten	6 tens	÷	3	=	2 tens
1 ten and 2 ones = 12 ones	12 ones	÷	3	=	4 ones
12 ones ÷ 3 = 4 ones	72	÷	3	=	24

Initially, this should be supported by the use of a representation such as straws, and a clear use of unitising language, so the children have a deep understanding of the structure of division. A problem-solving context will allow the steps to be explored in detail.

Seventy-two sticks are shared equally between three children. How many sticks does each child get?

'Three tens are one ten each. That's thirty.'

'Six tens are two tens each. That's sixty.'

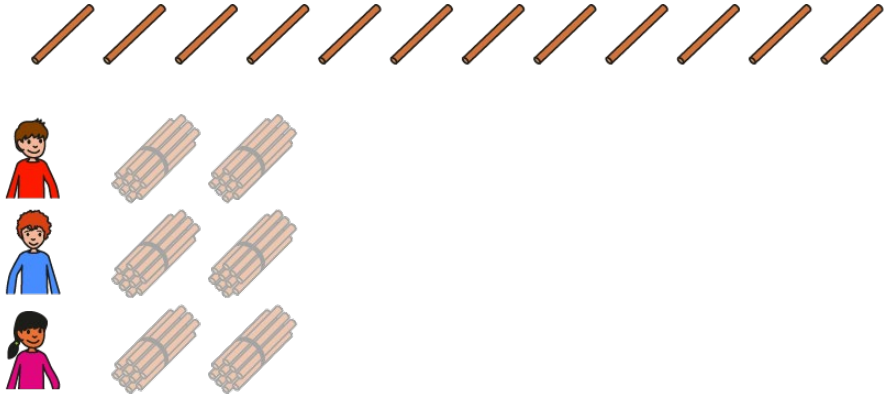
'There is one ten left over.'

'7 tens ÷ 3 = 2 tens r 1 ten'

'Seven tens divided between three is equal to two tens each, with a remainder of one ten.'

Unbundling the remaining ten: 'One ten is equal to ten ones.'

'So, one ten and two ones are equal to twelve ones.'



'Three ones are one each. That's three.'

'Six ones are two each. That's six.'

'Nine ones are three each. That's nine.'

'Twelve ones are four each. That's twelve.'

'12 ones ÷ 3 = 4 ones'

'Twelve ones divided between three is equal to four ones each.'

'2 tens and 4 ones is 24, so each child gets 24 sticks. '

The next step is to move to short division. In this example, a remainder has been included. However, you would initially start with numbers where each digit of the dividend is a multiple of the divisor. Then, use numbers where there wasn't an overall remainder, before introducing one, following the same process as when using an informal written method.

Again, the context of sticks has been used but this time using place value counters as the representation, to expose the structure.

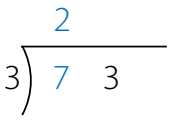
Seventy-three sticks are shared equally between three children. How many sticks does each child get?
73 ÷ 3 = ?

Step 1 – write the divisor and dividend

$3\overline{)\ 7\ \ 3}$

'Seventy-three divided by three.'

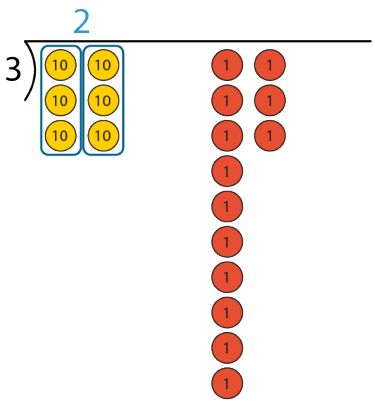
Step 2 – share the tens…

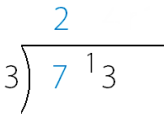


7 tens ÷ 3 = 2 tens r 1 ten

'Write "2" in the tens column…'

Step 3 – …and exchange

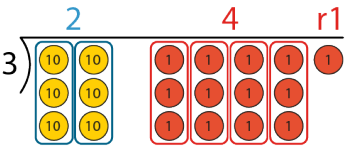


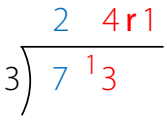


1 ten = 10 ones

'…and write "1" to the left of the ones digit of the dividend to make thirteen ones.'

Step 4 – share the ones





13 ones ÷ 3 = 4 ones r 1 one

'Write "4 r 1" in the ones column.'

Once children are confident using both the informal partitioning structure and the short division written algorithm for two-digit divided by one-digit numbers, the same processes can be followed for three-digit and four-digit numbers, divided by one-digit.

When rounding in context, questions will often ask children for a whole-number answer when there has been a remainder. For example, *'How many tables will be needed?'* or *'How many full boxes will there be?'* It is important that children consider the context of the problem to decide whether they will need to round up or down.

Common errors in this area may include:

- children not having the fluency in multiplication to support division
- ignoring the remainders
- not knowing when to round up or down after division
- writing the remainder in the tenths column.

What to look for

Can a child:

- explain the value of the digits within the calculation and why they are positioned where they are?

Links to supporting materials:

NCETM Primary Professional Development materials, Spine 2: Multiplication and Division:

- Topic 2.15: Division: partitioning leading to short division
- Topic 2.24: Division: dividing by two-digit divisors

Notes:
Key learning from support material and self-study:
What I will focus on developing in my classroom practice: