HARRINGTON HILL PRIMARY SCHOOL

CALCULATION POLICY

REVIEWED: February 2023

NEXT REVIEW DATE: February 2026

Adopted: February 2023

This policy sets out the calculation methods for KS2 at Harrington Hill. Please see the Maths Mastery 'Progression in Calculations' document, which sets out the calculation methods for EYFS and KS1.

What is the purpose of the policy?

The purpose of this calculation policy is to ensure consistency and progression in the teaching of the different calculation methods across the school. Along with the Progression in Calculation document for EYFS and KS1 , it aims to give an overview of the key written calculation strategies that will be taught in all year groups. All members of staff are expected to be familiar with this policy and apply it consistently across the school.

How is the calculation policy set out?

This calculation policy has been organised by year group, considering the national curriculum 2014 expectations. Each page refers to a different operation (addition, subtraction, multiplication and division) and shows a progression in calculation from Year 3 up to Year 6.

Written methods of calculations are based on mental strategies. Each of the four operations builds on mental skills which provide the foundation for jottings and informal written methods of recording. Skills need to be taught, practised and reviewed constantly. These skills then lead on to more formal written methods of calculation.

It is important that children do not abandon jottings and mental methods once formal written methods are introduced. Therefore children should always be encouraged to look at a calculation/problem and then decide which is the best method to choose. As children become more confident with their calculation, they need to use the following steps when approaching problems:

- 'Can I solve this problem in my head and use a mental method?'
- 'Do I need to use some written jottings to help me?'
- 'Do I need to use more formal written method to solve the problem?'

Concrete, Pictorial, Abstract Approach

The calculation policy is laid out in accordance with one of the key learning principles behind Maths Mastery, the Singapore approach at White Rose maths, as supported by the NCTEM. It supports how we teach maths, with challenge for all at the heart. The approach we use is concrete, pictorial and abstract (often referred to as the CPA approach). The concrete, pictorial, abstract approach, based on research by psychologist Jerome Bruner, suggests that there are three steps (or representations) necessary for pupils to develop understanding of a concept. Reinforcement is achieved by going back and forth between these representations.

Concrete representation

The active stage - a student is first introduced to an idea or a skill by acting it out with real objects. In division, for example, this might be done by separating apples into groups of red ones and green ones or by sharing 12 biscuits amongst 6 children. This is a 'hands on' component using real objects and it is the foundation for conceptual understanding.

Pictorial representation

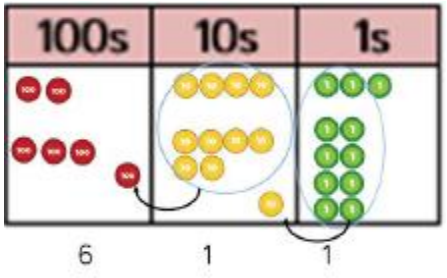
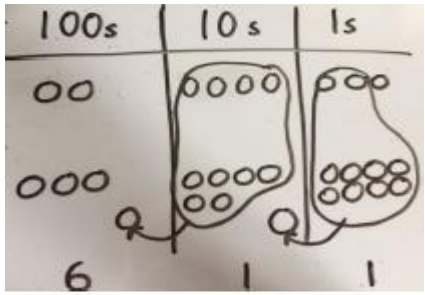
The iconic stage - a student has sufficiently understood the hands-on experiences performed and can now relate them to representations, such as a diagram or picture of the problem. In the case of a division exercise this could be the action of circling objects.

Abstract representation

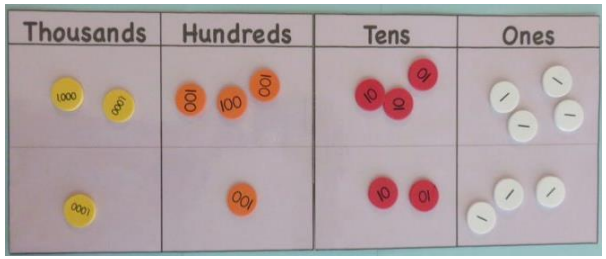
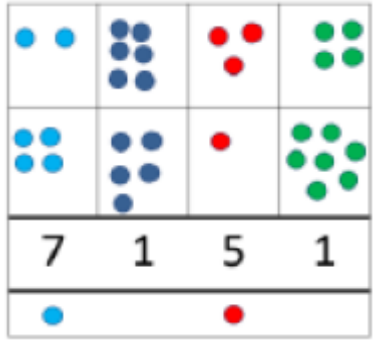
The symbolic stage - a student is now capable of representing problems by using mathematical notation, for example: $12 \div 2 = 6$.

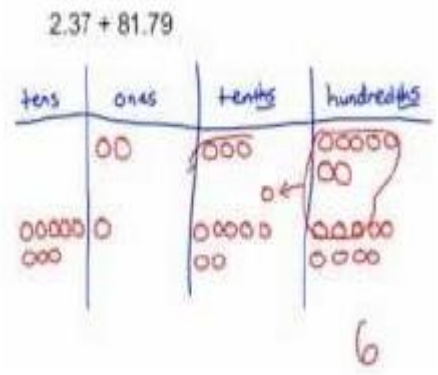
Addition

Year 3

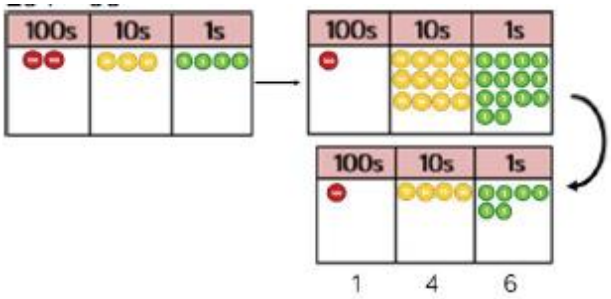
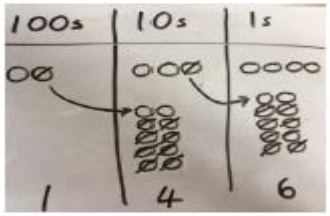
Strategies	Concrete	Pictorial	Abstract
Add numbers with up to three digits, using formal written methods of columnar addition.	Use of place value counters. When there are 10 ones in the 1s column- we exchange for 1 ten, when there are 10 tens in the 10s column- we exchange for 1 hundred. 	Children to represent the counters in a place value chart, circling when they make an exchange. 	Compact Column Addition 789 + 642 becomes 7 8 9 + 6 4 2 1 4 3 1 1 1 Answer: 1431 Add the units first, carry numbers underneath the bottom line, remind pupils of actual value e.g. 3 tens add 7 tens.

Year 4

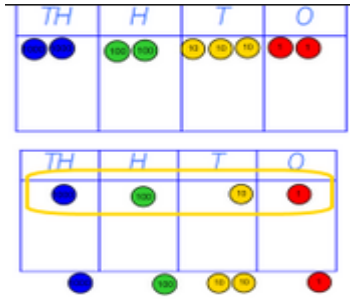
Strategies	Concrete	Pictorial	Abstract
Add whole numbers with more than 4 digits, including using formal written methods (columnar addition).	Continue to use dienes and place value counters to add, exchanging ten ones for a ten and ten tens for a hundred and ten hundreds for a thousand. 2,334 + 1,123 = 	Draw representations using place value diagram. 	Continue from previous work to carry hundreds and tens. Relate to money and measures. £ 32.50 + £ 21.75 = £54.25 £32.50 + £21.75 £54.25 1

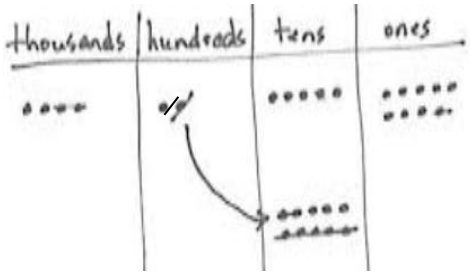
Year 5			
Strategies	**Concrete**	**Pictorial**	**Abstract**
Add numbers with more than 4 digits. Add decimals with 2 decimal places, including money.	Introduce decimal place value counters and model exchange for addition. 	Draw representations using PV grid. 	Tenths, hundredths and thousandths should be correctly aligned, with the decimal point aligned vertically including in the answer. Empty decimal places can be filled with the zero to show the place value of each column. 
Year 6			
Strategies	**Concrete**	**Pictorial**	**Abstract**
Add several numbers of increasing complexity.	As year 5		

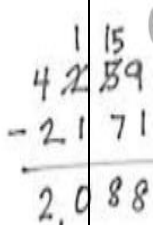
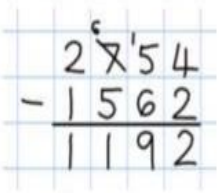
SUBTRACTION

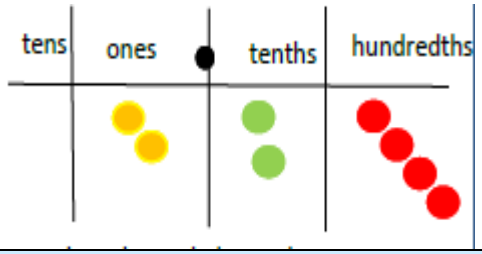
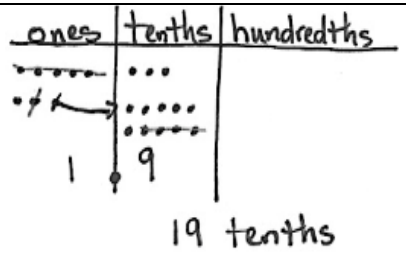
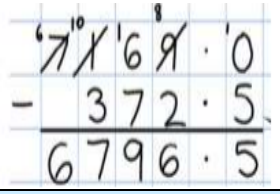
<table>
<tr><th colspan="4">Year 3</th></tr>
<tr><th>Strategies</th><th>Concrete</th><th>Pictorial</th><th>Abstract</th></tr>
<tr>
<td>Subtract numbers with up to three digits, using formal written methods of columnar addition.</td>
<td>Use of place value counters.
234 – 88 = 146
 
</td>
<td>Represent the place value counters pictorially; remembering to show what has been exchanged.
234 – 88 = 146
 
</td>
<td>Expanded Column Subtraction leading to compact column method.
700 + 40 + 1
– 300 + 60 + 7

600 130 11
~~700~~ + ~~40~~ + ~~1~~
– 300 + 60 + 7
300 + 70 + 4

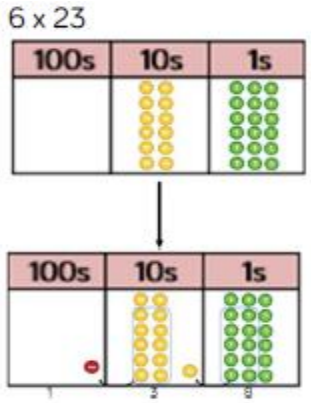
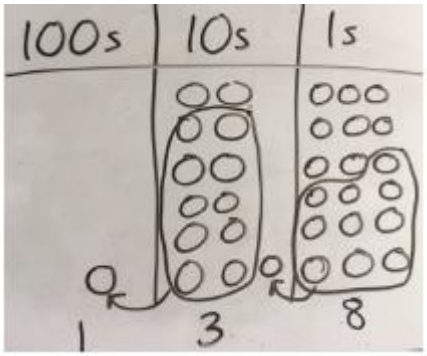
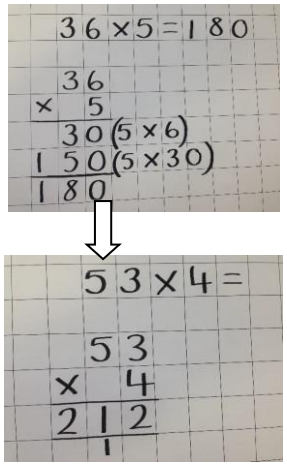
6 13 11
~~7~~ ~~4~~ ~~1~~
– 3 6 7
3 7 4</td>
</tr>
<tr><th colspan="4">Year 4</th></tr>
<tr><th>Strategies</th><th>Concrete</th><th>Pictorial</th><th>Abstract</th></tr>
<tr>
<td>Subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition).</td>
<td>Children continue to use place value counters to subtract.
 

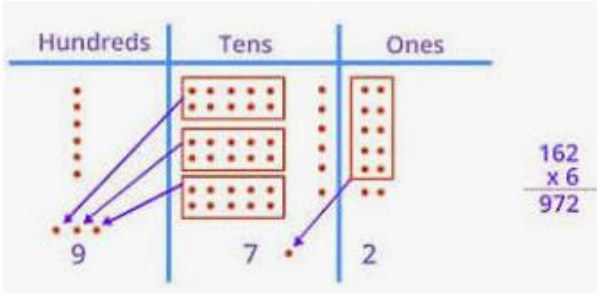
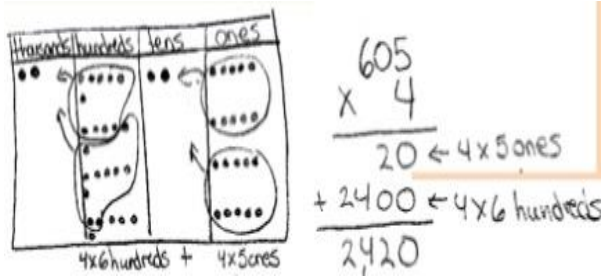
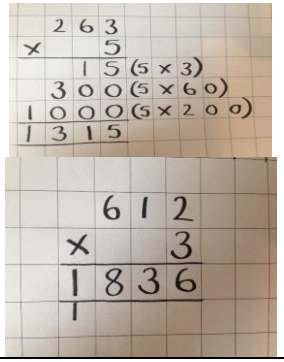
2232 – 1121 = 1111</td>
<td>Draw representations using place value diagram.
 


</td>
<td>Compact column method to subtract.
 
</td>
</tr>
<tr><th colspan="4">Year 5</th></tr>
<tr><th>Strategies</th><th>Concrete</th><th>Pictorial</th><th>Abstract</th></tr>
<tr>
<td>Subtract numbers</td>
<td>Introduce decimal place value counters and model exchange for subtraction.</td>
<td>Draw representations using PV grid.</td>
<td>Children will subtract with decimal values, including mixtures of integers and decimals and aligning the</td>
</tr>
</table>

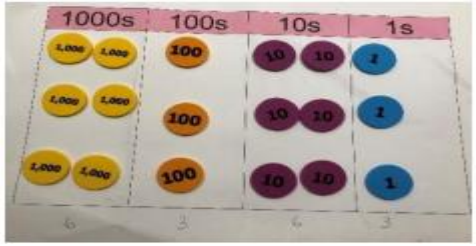
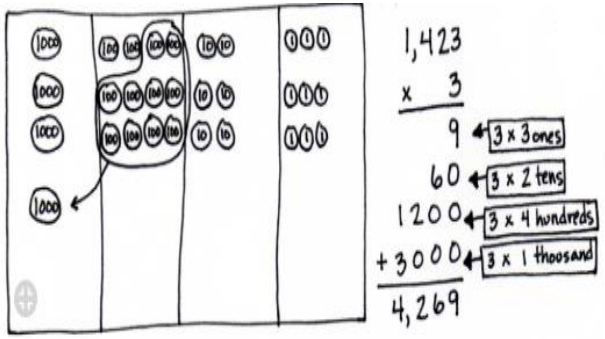
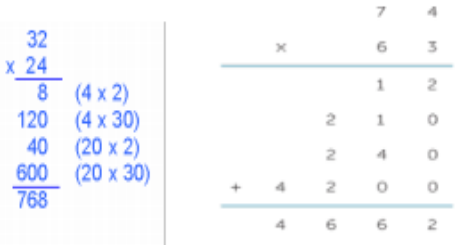
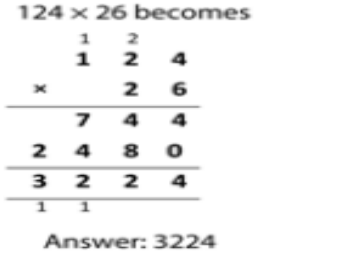
with more than 4 digits. Subtract decimals with 2 decimal places.			decimal point. A zero will be used in any empty decimal place to aid understanding of what to subtract. 
Year 6			
Strategies	**Concrete**	**Pictorial**	**Abstract**
Subtract more complex numbers and decimal values.	As year 5 using more complex numbers.		

Multiplication

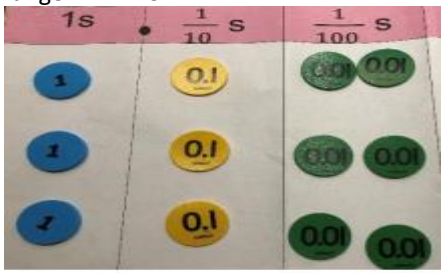
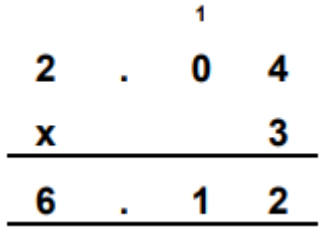
Year 3			
Strategies	**Concrete**	**Pictorial**	**Abstract**
Multiplying two digit numbers by one digit.	Use dienes or place value counters to show how we are finding groups of a number. Then start by counting the ones, then tens. Then progress to making exchanges. 	Represent the dienes or place value counters pictorially; remembering to show what has been exchanged. 	Expanded short multiplication leading to short multiplication. 

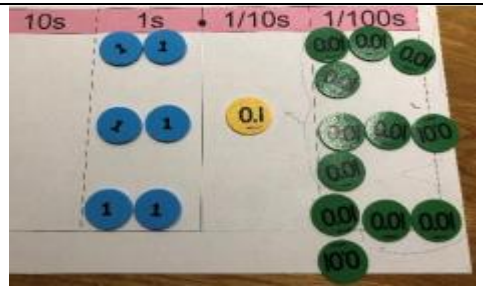
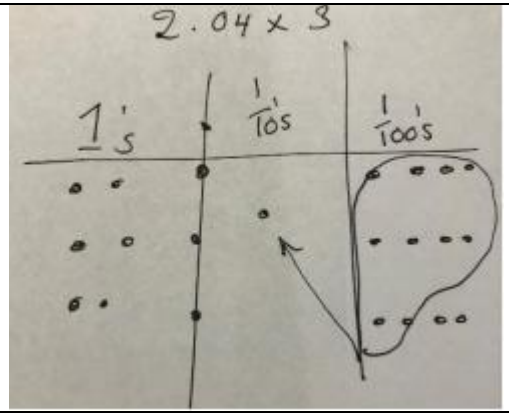
Year 4			
Strategies	**Concrete**	**Pictorial**	**Abstract**
Multiplying two and three digit numbers by one digit.	Use dienes or place value counters to show how we are finding groups of a number. Then start by counting the ones, then tens and hundreds. Then progress to making exchanges. 	Represent the dienes or place value counters pictorially; remembering to show what has been exchanged. 	Expanded Short Multiplication leading to Short Multiplication: 

Year 5

Strategies	Concrete	Pictorial	Abstract
Multiply numbers up to 4 digits by a one or two digit number.	Pupils to use place value counters to represent 4 digit x 1 digit calculations. 2,121 x 3 = 	Pupils to represent place value counters pictorially. 	Consolidate short multiplication before moving on to expanded long multiplication:  Once secure introduce formal long multiplication: 

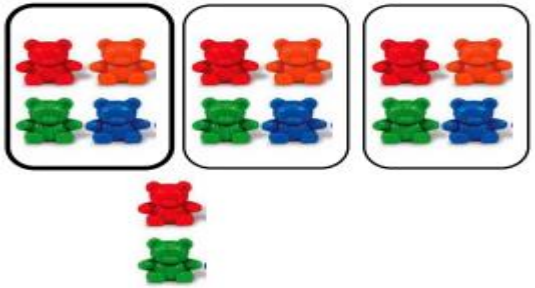
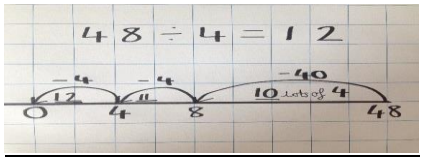
Year 6

Strategies	Concrete	Pictorial	Abstract
Multiply numbers up to 4 digits by a one or two digit number. (See Year 5) Multiplying decimals up to 2 places by a whole number.	Use place value counters to multiply decimals. No exchange: 1.12 x 3  With exchange: 2.04 x 3	Use pictorial representations.	Formal method for multiplication. 

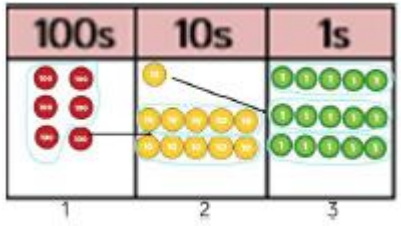
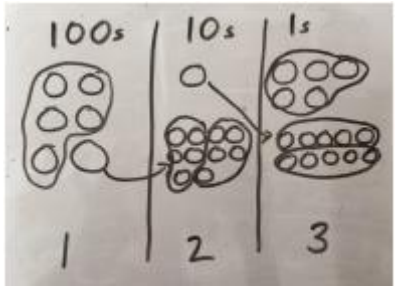
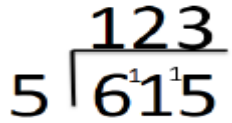
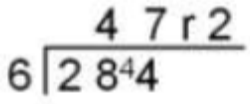
	 10s 1s 1/10s 1/100s 0.1	 2.04 x 3 1's 1 Tos 1 Toos	

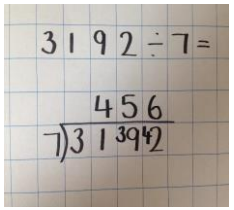
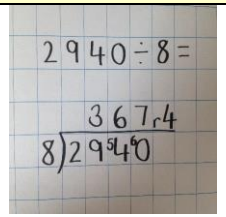
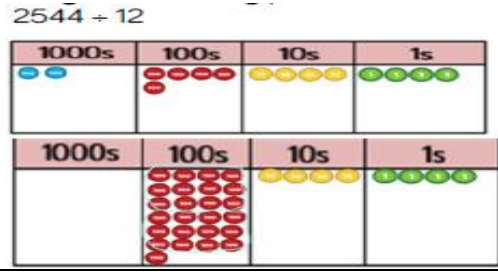
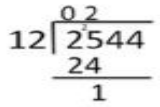
Division

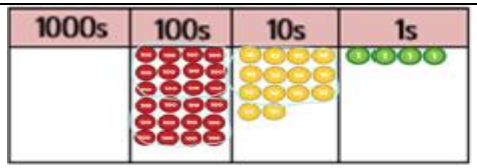
Year 3

Strategies	Concrete	Pictorial	Abstract
Dividing two digit numbers by one digit including with remainders.	Divide objects between groups and see how much is left over. 	Children to carry out grouping pictorially using dots or crosses. 	Abstract number line showing repeated groups subtracted and remainder using times tables facts to help them.  Encourage children to take larger chunks using 'friendly' multiples of 2, 5 and 10. 

Year 4

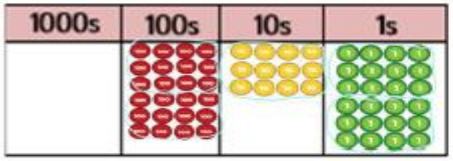
Strategies	Concrete	Pictorial	Abstract
Dividing two and three digit numbers using short division, including remainders.	Short division using place value counters to group. 615 ÷ 5 =  1. Make 615 with place value counters 2. How many groups of 5 hundreds can you make with 6 hundred counters? 3. Exchange 1 hundred for 10 tens. 4. How many groups of 5 tens can you make with 11 ten counters? 5. Exchange 1 ten for 10 ones. 6. How many groups of 5 ones can you make with 15	Represent the dienes or place value counters pictorially; remembering to show what has been exchanged. 	Children to represent the calculation using the short division scaffold:  Once the children are confident with this, they can then move on to using short division with remainders. 

	ones?		
Year 5			
Strategies	**Concrete**	**Pictorial**	**Abstract**
Divide four digit numbers by one digit including remainders.	Continue to use place value counters as in year 4.	Continue to represent place value counters pictorially as in year 4.	  Answers could also be given as remainders, decimals or fractions e.g. 2940 ÷ 8 = 367 r4 = 367 1/2 = 367.5
Year 6			
Strategies	**Concrete**	**Pictorial**	**Abstract**
Divide four digits numbers by two digit numbers using long division.	Use Place value counters alongside the calculation.	 We can't group 2 thousands into groups of 12 so will exchange them. We can group 24 hundreds into groups of 12 which leaves with 1 hundred.	



After exchanging the hundred, we have 14 tens. We can group 12 tens into a group of 12, which leaves 2 tens.

$$\begin{array}{r} 021 \\ 12\overline{)2544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 2 \end{array}$$



After exchanging the 2 tens, we have 24 ones. We can group 24 ones into 2 group of 12, which leaves no remainder.

$$\begin{array}{r} 0212 \\ 12\overline{)2544} \\ \underline{24} \\ 14 \\ \underline{12} \\ 24 \\ \underline{24} \\ 0 \end{array}$$