Maths Calculation Policy 2024 - 2025

This policy supports the White Rose maths scheme used throughout the school. Progression within each area of calculation is in line with the programme of study in the 2014 National Curriculum. This calculation policy should be used to support children to develop a deep understanding of number and calculation. This policy has been designed to teach children through the use of concrete, pictorial and abstract representations.

- Concrete representation— a pupil is first introduced to an idea or skill by acting it out with real objects. This is a 'hands on' component using real objects and is a foundation for conceptual understanding.
- Pictorial representation – a pupil has sufficiently understood the 'hands on' experiences performed and can now relate them to representations, such as a diagram (including Bar/Part, part models) or picture of the problem.
- Abstract representation—a pupil is now capable of representing problems by using mathematical notation, for example 21 + 123 = 144

It is important that conceptual understanding, supported by the use of representation, is secure for all procedures. Reinforcement is achieved by going back and forth between these representations.

Mathematics Mastery

At the centre of the mastery approach to the teaching of mathematics is the belief that all children have the potential to succeed. They should have access to the same curriculum content and, rather than being extended with new learning, they should deepen their conceptual understanding by tackling challenging and varied problems. Similarly, with calculation strategies, children must not simply rote learn procedures but demonstrate their understanding of these procedures through the use of concrete materials and pictorial representations. This policy outlines the different calculation strategies that should be taught and used in EYFS and Year 1 to Year 6.

How to use the policy:

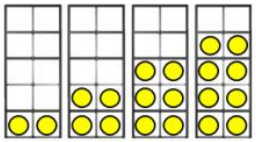
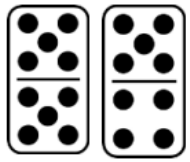
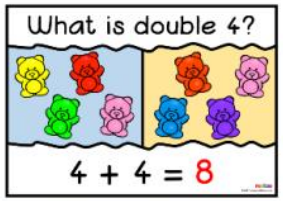
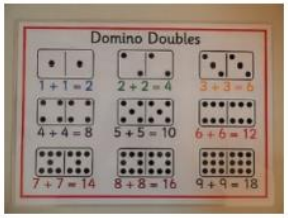
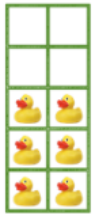
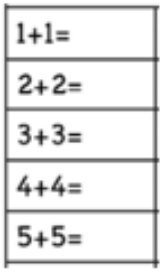
This mathematics policy is a guide for all staff in Reynolds Academy and has been adapted from work by White Rose and Third Space. All teachers have been given the scheme of work from White Rose and are required to base their planning around their year group's modules and not to move onto a higher year group's scheme of work (teachers may use previous year group's modules for children whom are not yet secure in their year groups modules). These modules use the Singapore Maths Methods and are affiliated to the workings of the 2014 Maths Programme of Study. Teachers can use any teaching resources that they wish to use and the policy does not recommend one set of resources over another, rather that, a variety of resources are used.

For each of the four rules of number, different strategies are laid out, together with examples of what concrete materials can be used and how, along with suggested pictorial representations. The principle of the concrete-pictorial-abstract (CPA) approach is for children to have a true understanding of a mathematical concept, they need to master all three phases within a year group's scheme of work.

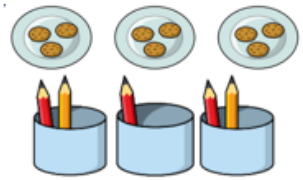
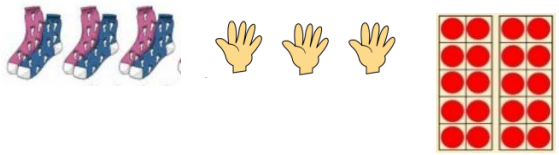
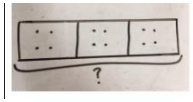
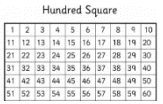
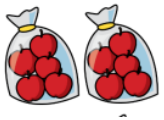
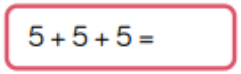
*Use stem sentences from White Rose or Third Space to support children to embed the concept.

Multiplication

Multiplication – EYFS

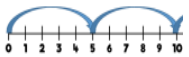
Objective and Strategy	Concrete	Pictorial	Abstract
Doubling	Use counting and concrete objects to add equal groups.     *Pair-wise pattern* Build numbers using the pairwise patterns on 10 frames helps the children to see the doubles.  Provide examples of doubles and non-doubles for the children to sort and explain why. Use real life examples that encourage children to see concept of doubling as adding two equal groups. 	 Use pictures and icons that encourage children to see concept of doubling as adding two equal groups.  	 Write addition calculations to model adding two equal groups. * No expectation for children to be able to record a multiplication calculation formally.

Multiplication – Year 1

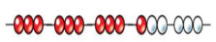
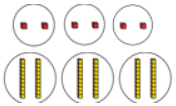
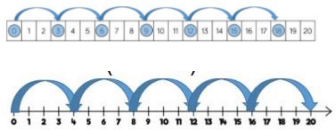
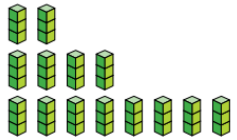
Objective and Strategy	Concrete	Pictorial	Abstract
Follow EYFS for Doubling numbers up to 20. Solve one-step problems involving multiplication, by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher. Recognising equal and unequal groups. Count in multiples of 2s, 5s and 10s.	 Arrange objects in equal and unequal groups for children to recognise and explain how they know they are equal. Find the total of equal groups by counting in 2, 5, and 10's using repeated addition.  Children to make connections between arrays, number patterns, and counting in twos, fives and tens.	 Children draw and represent equal and unequal groups using bar models.   Use 100 squares to support counting in 2s, 5s and 10s.  Solve problems such as: There are 5 apples in one bag. How many apples altogether in two bags?	Say and write stem sentences alongside number sentences such as 'There are three equal groups of 5.'  Repeated addition - to support counting in 2, 5 and 10's  Use number lines to reinforce repeated addition counting in 2s, 5s and 10s. * No expectation for children to be able to record a multiplication calculation formally.

Multiplication – Year 2

Objective and Strategy	Concrete	Pictorial	Abstract
Follow on from Year 1 - recognising equal and unequal groups. Recall and use multiplication facts for the 2, 5 and 10 multiplication tables. Calculate mathematical statements and write them using the × and = signs.	 Use concrete objects such as: numicon, counters and unifix cubes to make arrays and explore commutitivity.  Use concrete objects when learning multiplication facts for the 2s, 5s and 10s.	 Recognise equal groups and connect them to repeated addition and multiplication. 5 + 5 + 5 + 5 = 20 4 x 5 = 20  Use representations of arrays to show different calculations and to explore commutativity. 2 x 4 = 8 4 x 2 = 8	 Introduce children to the multiplication symbol alongside repeated addition. 5 + 5 + 5 + 5 = 20 4 × 5 = 20 5 × 4 = 20 *Use commutativity and inverse relations to develop multiplicative reasoning (for example, 4 × 5 = 20 and 20 ÷ 5 = 4).

Show that multiplication of 2 numbers is commutative. Solve problems using materials, arrays, repeated addition, mental methods, and multiplication facts, including problems in contexts. Count in steps of 2, 3, and 5 from 0, and in 10s from any number, forward and backward.	<table><tr><th>Model</th><th>Calculation</th></tr><tr><td></td><td></td></tr></table> *Showing the calculation alongside the model will help children to see the connection.	Use pictorials such as 100 squares and number lines to count in steps of 2s, 3s and 5s from 0 and in 10s from any number, forwards and backwards.   <table><tr><th>Model</th><th>Calculation</th></tr><tr><td></td><td></td></tr></table> *Showing the calculation alongside the model will help children to see the connection.	

Multiplication – Year 3/4

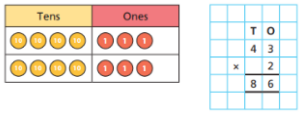
Objective and Strategy	Concrete	Pictorial	Abstract
Follow on from Year 2 – understanding repeated addition and equal grouping. **Year 3** Multiplication facts for the 3, 4 and 8 multiplication tables. Use known facts to multiply multiples of 10. Multiply 2-digit numbers by 1-digit numbers using mental and progressing to formal written methods. Solve problems, involving multiplication. **Year 4**	 Use concrete objects when learning multiplication facts for the 3s, 4s and 8s.   Bead strings and numicon can support children in their understanding of multiplication as repeated addition. 3 + 3 + 3 + 3 + 3 = 15 5 x 3 = 15 3 x 5 = 15  Explore the relationship between known times tables and multiples of 10 using place value equipment. 3 x 2 = 6 3 x 20 = 60 Represent a two-digit number multiplied by a one-digit number using concrete manipulatives.	Use arrays and pictorials to recognise commutativity and to understand how times tables facts relate to commutativity.  3 x 4 = 12 4 x 3 = 12  Use number lines/tracks to count in multiples, forwards and backwards. Through doubling, children connect the 2, 4 and 8 multiplication tables. ▸ 3 × 2 = _____ ▸ 3 × 4 = _____ ▸ 3 × 8 = _____ 	Understand how to use known times-tables to multiply multiples of 10. 3 x 5 = 15 30 x 5 = 150 Use partitioning and addition to complete multiplications of 2-digit numbers by a 1-digit number. *4 × 13 = ?* *4 × 3 = 12* *4 × 10 = 40* *12 + 40 = 52* *4 × 13 = 52* Multiply two and three-digit numbers by a one-digit number showing the clear addition alongside the grid method. <table><tr><th>×</th><th>30</th><th>5</th></tr><tr><td>7</td><td>210</td><td>35</td></tr></table> **210 + 35 = 245**

Multiplication facts up to 12 × 12.

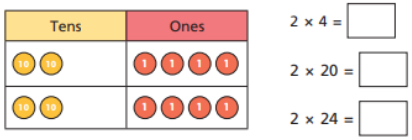
Multiplying by 0 and 1; multiplying together 3 numbers.

Multiply two and three-digit numbers by a one-digit number using formal written layout.

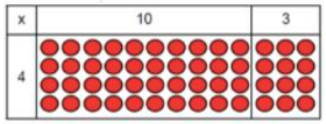
Explore multiplication with no exchange before moving on to multiplication with exchange.



Link partitioning a 2-digit number with multiplying.



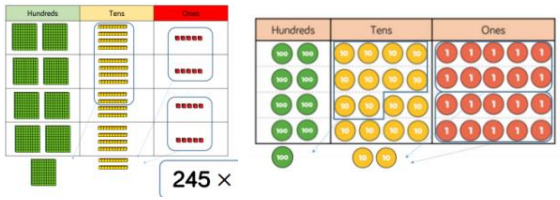
Show the link with arrays to first to introduce the grid method.



4 rows of 10
4 rows of 3

4 rows of 13

Use Base 10 and place value counters to support the understanding of the written method.

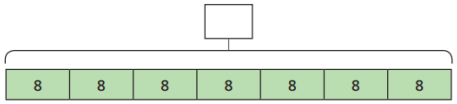


Add up each column, starting with the ones making any exchanges needed.

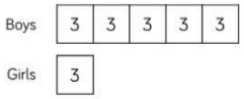
Model	Calculation

*Show the calculation and grid method alongside manipulatives will help children to see the connection.

Use bar models to support multiplication,

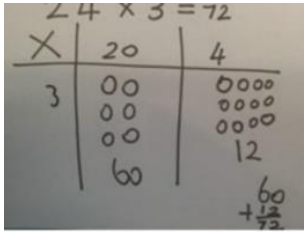


Use bar models to support scaling.



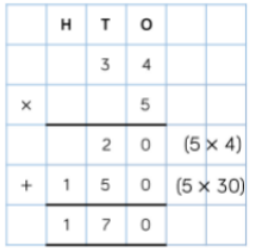
There are 3 girls in a group. There are 5 times more boys than girls. How many boys are in a group?

Children represent the work they have done with place value counters/Base 10.



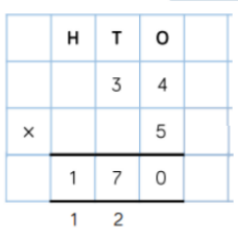
Model	Calculation

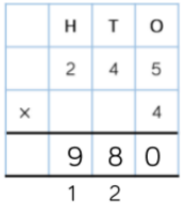
*Show the calculation alongside pictorials.



Write calculations in expanded column form, ensuring children understand the link with place value and exchange.

Move onto using the formal written method of short multiplication





*Digits exchanged and regrouped to be written below the line and the multiplication symbol to the left of the calculation.

*Use multiplication grids to support children who struggle with times tables.

Multiplication – Year 5 and 6

Objective and Strategy

Follow on from year 3/4 for multiplying using concrete resources and formal methods of multiplication.

Multiply numbers up to 4 digits by a one or two-digit number using a formal written method, including long multiplication for two-digit numbers.

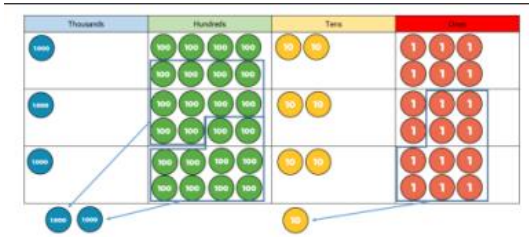
Solve problems involving multiplication.

Year 6

Multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication.

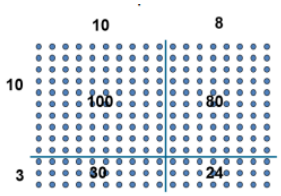
Concrete

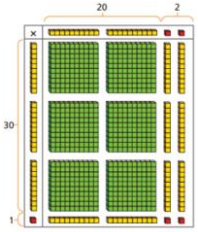
Continue to use place value counters to support multiplication.

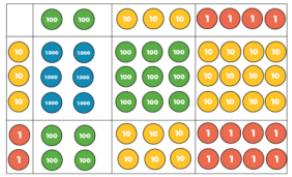


* Show how the concrete method links to the abstract method alongside your working. Cross out the numbers when exchanging and show where to write the new amounts.

Use arrays, area models and place value counters to support multiplying numbers by 2-digits.





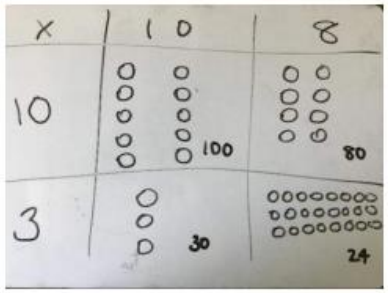


×	200	30	4
30	6,000	900	120
2	400	60	8

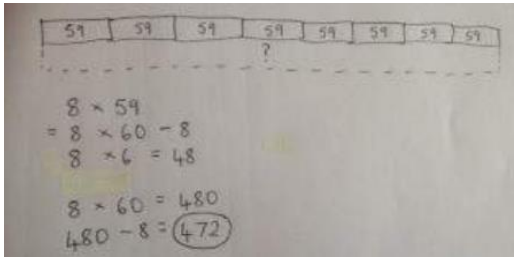
*Show the grid method alongside the area model as an initial written method before moving on to the formal written long multiplication mehtod.

Pictorial

Children continue to represent the work they have done with place value counters in a way that they understand.



Bar modelling and number lines can support learners when solving problems with multiplication alongside the formal written methods.



Model	Calculation

*Showing the calculation alongside pictorials will help children to see the connection.

Abstract

	Th	H	T	O
	1	8	2	6
×				3
	5	4	7	8
		2		1

Children continue to build on the formal written method of short multiplication

Use the grid and expanded method before moving onto formal written methods of long multiplication.

×	200	30	4
30	6,000	900	120
2	400	60	8

		1	4	3
×			1	2
		2	8	6	143 × 2
	1	4	3	0	143 × 10
	1	7	1	6	143 × 12
		1			

	H	T	O
		2	2
×		3	1
		2	2
	6	6	0
	6	8	2

Th	H	T	O
	2	3	4
×		3	2
	4	6	8
1 7	1 0	2	0
7	4	8	8

TTh	Th	H	T	O
	2	7	3	9
×			2	8
2 2	1 5	9 3	1 7	2
5 1	4	7 1	8	0
7	6	6	9	2

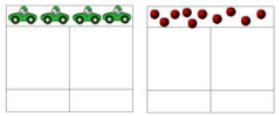
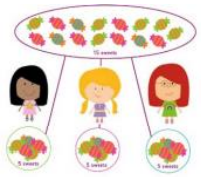
Children should be confident at using long multiplication when multiplying 4-digit numbers by 2-digit numbers.

* Ensure children line up numbers clearly in columns and place exchanged digits correctly.

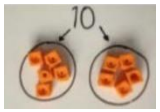
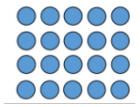
*Use multiplication grids to support children who struggle with times tables.

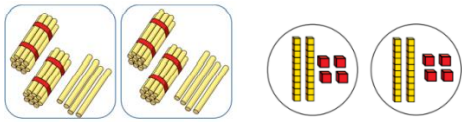
Division

Division– EYFS

Objective and Strategy	Concrete	Pictorial	Abstract
Solve problems including halving and sharing. • Halving a whole, halving a quantity of objects. • Sharing a quantity of objects.	Physically cut objects, food or shapes in half.     Use concrete resources for children to share into equal groups.  Use halving mats and part part whole models, with the physical objects and resources that can be manipulated.  Investigate whether small quantities are odd or even by sharing into 2 groups and by making pairs. Provide opportunities for the children to share items equally. *During snack time or group activities, encourage children to check that the items are shared equally and that everyone has the same.	  Use pictures and icons that encourage children to see concept of halving in relation to subitising, addition and subtraction knowledge. i.e. Knowing 4 is made of 2 groups of 2, so half of 4 is 2.  Use bar models with pictures or icons to share equally.  Use pictures for children to create and visualise 3 or more equal groups.	*No expectation for children to be able to record a division calculation formally.

Division– Year 1 and 2

Objective and Strategy	Concrete	Pictorial	Abstract
Follow EYFS for sharing quantities and halving amounts. Division as sharing and making equal groups	 Use concrete objects to share amounts into equal groups.  Use part part whole models and concrete resources to share and make equal groups from a whole.	 Use pictures or shapes to share quantities.  Use pictorial arrays to represent a whole and to work out how many equal groups	There are 20 apples altogether. They are put in bags of 5. How many bags are there? 8 ÷ 2 = 4 18 ÷ 2 = 9 48 ÷ 2= 24

Solve one-step problems involving division, by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher.	Count the number of equal groups using resources such as numican and number beads.  Use bar models and concrete resources to share and make equal groups from a whole.  Use concrete resources make equal and unequal groups.  *When moving onto dividing 2-digit numbers by the times tables that they know, use manipulatives that allow children to partition into tens and ones with no exchanges.  48 ÷ 2= 24 	Model	Calculation
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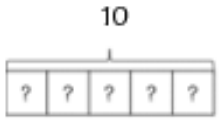
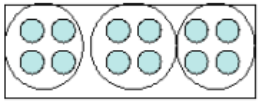
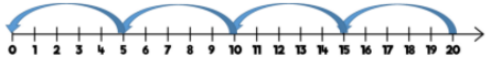
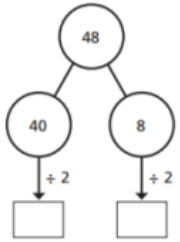
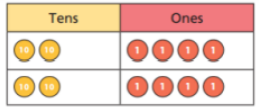
	| *Showing the calculation alongside manipulatives will help children to see the connection.	can be made for numbers up to 20. Use bar models to represent a whole and to share amounts.  Draw or sketch images/dots to help divide numbers up to 20.  Use number lines to show jumps in groups. Start with a whole and count back.  Use part-whole models and place value charts to provide children with a clear pictorial method that matches the concrete representation.   48 ÷ 2= 24 | Model	Calculation
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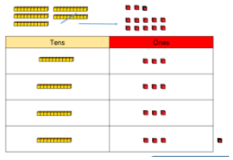
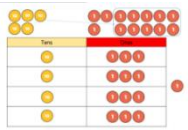
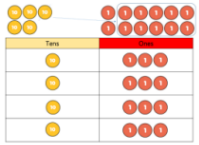
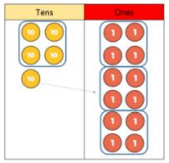
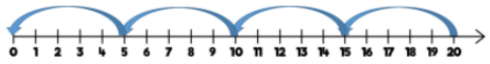
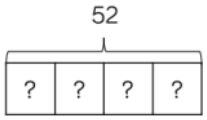
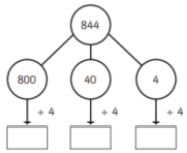
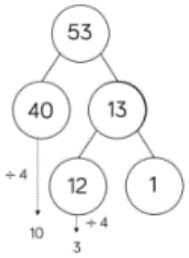
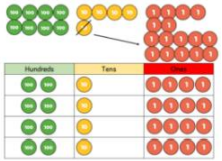
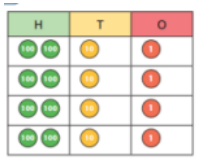
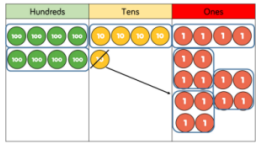
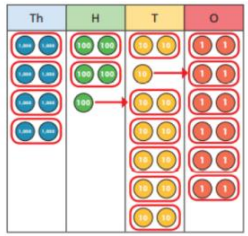
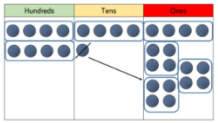
		 *Showing the calculation alongside pictorials will help children to see the connection.	* Even though there is no expectation for children in Year 1 to be able to record a division calculation formally, show the calculation alongside concrete and pictorial methods.

Division– Year 3 and 4

Objective and Strategy	Concrete	Pictorial	Abstract
Follow on from Year 2 for division of dividing 2-digit by 1-digit with no remainders and exchanges. Divide a 2- digit number 2 - digit by a 1-digit number with and without exchange. Divide a 2- digit number 2 - digit by a 1-digit number with and without remainders. Use known facts to divide multiples of 10.	Link division to multiplication by creating an array and thinking about the number sentences that can be created. 15 ÷ 3 = 5 5 x 3 = 15 15 ÷ 5 = 3 3 x 5 = 15  Use place value and Base 10 equipment to understand the concept of remainders.   *Start with the manipulatives outside the place value grid before sharing the tens and ones equally between the rows for both enchanging and remainders. Use Base 10 and Place value counters to exchange one ten for ten ones.  Use place value to group by the divisor to introduce the short method of division. 	Use number lines to show jumps in groups. Start with a whole and count back in equal groups.  Continue to use bar models, part whole models to divide and to show remainders. Provide a clear pictorial method that matches the concrete representation.     | Model	Calculation | |---|---| | | | *Showing the calculation alongside pictorials will help children to see the connection.	I know that 5 × 7 = 35 so I know all these facts: 5 × 7 = 35 7 × 5 = 35 35 = 5 × 7 35 = 7 × 5 35 ÷ 5 = 7 35 ÷ 7 = 5 7 = 35 ÷ 5 5 = 35 ÷ 7 52 ÷ 4 = 13 53 ÷ 4 = 13 r1 Begin with divisors that divide equally before moving onto the short method with remainders.  

	Children continue to use place value to share 3-digit numbers equally. This will also help children identify remainders.   | Model | Calculation | | | | *Showing the calculation alongside manipulatives will help children to see the connection.		

Division– Year 5 and 6

Objective and Strategy	Concrete	Pictorial	Abstract
Follow on from Year 4 using short methods of division with exchanges and remainders.	Continue to model using place value counters to show division of 4 digits with exchanges and remainders.   | Model | Calculation | | | | *Showing the calculation alongside manipulatives will help children to see the connection. * Children should be encouraged away from the concrete and pictorial when dividing numbers with multiple exchanges and when dividing up to 4digits by 2-digits.	Children to continue to draw place value counters. Provide the children with a pictorial that matches the concrete representation.  | Model | Calculation | | | | *Showing the calculation alongside pictorials will help children to see the connection. * Children should be encouraged away from the concrete and pictorial when dividing numbers with multiple exchanges and when dividing numbers up to 4-digits by 2-digits.	$8{,}532 \div 2 = 4{,}266$ Continue with the short method showing exchanges and remainders. | | 4 | 2 | 6 | 6 | | 2 | 8 | 5 | $1^{1}3$ | $1^{1}2$ | $5\overline{)4\,3\,2}$ = 8 6 r 2 (3) Once children understand remainders, begin to express as a fraction or decimal according to the context. $5\overline{)9\,{}^{4}3\,{}^{3}1}$ = 1 8 6 1/5 $35\overline{)5\,1\,1.0}$ = 14.6 (16, 21) | | 0 | 4 | 8 | 9 | | 15 | 7 | $7^{7}3$ | $13^{13}3$ | $13^{13}5$ |
