Glebe Primary School

'We can and we will'

Calculation Policy UKS2

Mental and Written calculations

Contents:

Mission Statement:

At Glebe School we believe in an ethos that values the whole child. We strive to enable all children to achieve their full potential academically, socially and emotionally.

Introduction:

At Glebe Primary School, children are introduced to the process of calculation through practical, oral, and mental activities. As children begin to understand the underlying ideas, they develop ways of recording to support their thinking. Over time, children learn how to use models and images (such as empty number lines) to support the mental and informal written calculations. As children's mental methods are strengthened and refined, so too are their informal written methods. These methods become more efficient and succinct and lead to efficient written methods that can be used more generally.

The range of methods taught are designed to enable children to:

- Become confident, independent and efficient in their calculations;
- Choose the appropriate operation and methods (from a variety of mental and written methods) rather than rely on formal written methods for all calculations;
- To solve a particular calculation;
- Develop strategies for checking accuracy i.e using the inverse to check their answers.

At whatever stage in their learning, and whatever method is being used, it must still be underpinned by a secure and appropriate knowledge of number facts, along with the mental skills that are needed to carry out the process and judge if was successful.

The overall aim is that when children leave primary school they:

- Have a secure knowledge of number facts and a good understanding of the four operations;
- Are able to use this knowledge and understanding to carry out calculations mentally and apply general strategies to special cases involving bigger numbers;
- Make use of diagrams and informal notes to help record steps and multi-step answers; when using mental methods, that generate more information than can be kept in their heads.
- Have an efficient, reliable, compact written method, for each operation, that children can apply with confidence when undertaking calculations that they cannot carry out mentally.

To add successfully, children need to be able to:

- Know the vocabulary which indicates addition: sum, total, greater, more etc.
- Recall addition pairs to 10 & 100 (such as 2 + 8 = 10 & 20 + 80 = 100);
- To add mentally a series of numbers (such as 5 + 8 + 4);
- Add multiples of 10 (such as 60 +70) or of 100 (600+ 700) using related addition facts (6 + 7) and their knowledge of place value;
- Partition two-digit & three-digit numbers, into multiples of 1, 10 and 100 in different ways.

To subtract successfully, children must be able to:

- Know the vocabulary which indicates subtraction: less, fewer, difference etc.
- Recall all addition and subtraction facts to 20 (such as 12 + 8 = 20);
- Subtract multiples of 10 (such as 160 -70) using related subtraction facts (16 - 7) and their knowledge of place value;
- Partition two-digit and three-digit numbers into 1s, 10s and 100s, in a number of different ways (such as partition 74 into 70 + 4 or 60 + 14)

To multiply successfully, children need to:

- Recall all multiplication facts to 12 x 12;
- Know the vocabulary which indicates multiplication: multiple, multiply, lots of, double, triple etc;
- Partition numbers into multiples of 1s, 10s and 100s;
- Work out products (such as 70 x 5, 70 x 50, 700 x 5) using the related fact (7 x 5) and their knowledge of place value;
- Add two or more single digits mentally;
- Recognise that multiplication is repeated addition;
- Add multiples of 10 or of 100 using related addition facts and their knowledge of place value;
- Add combination of decimal or larger whole numbers using formal written methods (the column method).

To divide successfully, children need to be able to:

- Understand the vocabulary which indicates division: share, groups, quotient, half, quarter etc;
- Understand the vocabulary of division (such as 18 ÷3 = 6 18 is the dividend, the 3 is the divisor & the 6 is quotient;
- Partition two-digit and three-digit numbers into multiples of 1s, 10s and 100s.
- Recall multiplication and division facts 12 x 12;
- Recognise multiples of one-digit numbers and divide multiples of 10 or 100 by a single numbers using their knowledge of division facts;
- Know how to find a remainder, working mentally for example to find the remainder when 48 is divided by 5.
- Understand that multiplication and division are inverse operations;
- Understand division as repeated subtraction.

Reviewed: January 2022

To be reviewed: January 2024

CALCULATION PROGRESSION CHART Appendix 1

	Addition	Subtraction	Multiplication	Division
Year 1	• Using **concrete objects and other models** and images to understand addition.	• Using **concrete objects and other models** and images to understand subtraction.	• Using **concrete objects** to understand **multiplication** as "**lots of**" and as arrays (with teacher support).	• Using **concrete objects to understand division** as **sharing** and grouping.
Year 2	• Using concrete objects and models and **images including number lines** for **U+1s, TU+10s, U+U, TU+U** (see mental calculation for further exemplification). • Using **Base 10 apparatus** for **TU + TU** (beginning to set out in columns and recorded as expanded column addition).	• Using **concrete objects** and other models and images including number lines for **U-U, TU-U, TU - 10s** (see mental calculation in the policy for further exemplification)	• Using **concrete objects** and other models and images including **arrays** and number lines to **multiply U x** U and understand its relation to scaling including **doubling**.	• Using **concrete objects** and other models and images **including arrays** and **number lines** to embed understanding of division as "**grouping**" and "**sharing**" and relate **halving** to dividing by 2.
Children continue to learn using concrete resources and models and images in Lower and Upper KS2 to help develop conceptual understanding				
Year 3	• **Consolidation of mental methods** (see mental calculation in the policy for further exemplification). • Expanded column addition for **TU + TU, HTU + TU and HTU + HTU** where necessary.	• **Consolidation of mental methods** (see mental calculation in the policy for further exemplification). • **Expanded column subtraction** with decomposition for HTU – TU and HTU – HTU where necessary.	• Using **concrete objects** and other models and images including **arrays and number lines** to multiply and its relation to **scaling**. • **Consolidation of mental methods** including using knowledge of number facts to derive related facts of TU x U : If 2 x 3 = 6 then 2 x 30 = 60.	• **Consolidation of mental** methods including using **knowledge of number facts to derive related facts** of TU ÷ U: For example, using 3 × 2 = 6 for 30 × 2 = 60 and 6 ÷ 3 = 2, and 60 ÷ 3 = 20. • **Use number lines** to calculate **TU ÷ U** where appropriate (including remainders) by **chunking** on in groups of U.
Year 4	• **Consolidation of mental methods (see mental calculation** in the policy for further exemplification). • **Formal- Compact column addition up to 4 digits.**	• **Consolidation of mental methods** (see mental calculation in the policy for further exemplification). • **Expanded column subtraction with decomposition up to 4 digits.**	• **Consolidation of mental methods** (see mental calculation in the policy for further exemplification). • **Grid multiplication** (using arrays as starting point) for HTU x U and TU x U. • **Formal- Short multiplication for multiplying numbers up to 4 digits with U.**	• **Consolidation of mental methods** (see mental calculation in the policy for further exemplification) • **Use number lines to calculate TU÷U or HTU ÷U using chunks of 10** *(chunking on **using repeated addition**).*

Year 5	• **Consolidation of mental methods (see mental calculation** in the policy for further exemplification).
	• **Formal- Compact column addition including:**
	  • **Numbers up to 5 digits**
	  • **Same number of decimal places**
	  • **Different number of decimal places.**
		• **Consolidation of mental methods** (see mental calculation in the policy for further exemplification).
		• **Formal- Compact column subtraction with decomposition for subtracting whole numbers and numbers with the same decimal places.**
			• **Consolidation of mental methods** (see mental calculation in the policy for further exemplification).
			• Consolidate **grid method.**
			• **Consolidate formal short multiplication.**
				• **Consolidation of mental methods** (see mental calculation in the policy for further exemplification).
				• **Consolidate using number lines** to chunk groups on a number line for TU÷U & now for **HTU÷TU- chunking as repeated subtraction**.
				Formal - Short division for TU ÷ U (Bus stop method)
				• **Calculations with no "carrying" (e.g. 96 ÷ 3)**
				• **Calculations with "carrying" (e.g. 72 ÷ 3)**
				• **Calculations with "carrying" and remainders (e.g. 5309 ÷ 8)**
				• **Remainders as fractions.**

Year 6	• **Consolidation of mental methods** (see mental calculation in the policy for further exemplification). • **Formal- Compact column addition to add several numbers of increasing complexity including numbers with different number of decimal places.**	**Consolidation of mental methods** (see mental calculation in the policy for further exemplification). **Formal- Compact column subtraction with decomposition to subtract numbers of increasing complexity including numbers with different number of decimal places.**	• **Consolidation of mental methods** (see mental calculation in the policy for further exemplification). • **Formal- Short multiplication to multiply numbers with up to 2 decimal places by U.** • **Long multiplication for multiplying numbers up to 4 digits and numbers up to 2 decimal places by TU.**	• **Consolidation of mental methods** (see mental calculation in the policy for further exemplification) • **Formal method- Consolidate short division bus stop method, with and without remainders as whole numbers, fractions, decimals.** • **Formal Long division with TU as divisors.**

Progression of Challenge- in Calculations Appendix 2

Addition	Subtraction	Multiplication	Division
Choice of method could be mental or written (column addition) based on the calculation.	Choice of method could be mental or written (decomposition) based on the calculation.	Mental methods to be used where applicable.	Mental methods to be used where applicable.
U + U - below 10 (5 + 4) U + U - crossing tens boundary (5 + 7) TU + U - below 20 (15 + 4) TU + U – crossing tens boundary (35 + 8) TU + TU – within tens boundary (23 + 34) TU + TU – crossing tens boundary (26 + 48) TU + TU – crossing hundreds boundary (78 + 34) HTU + TU – within tens boundary (134 + 25) HTU + TU – crossing tens boundary (235 + 68) HTU + TU – crossing hundreds boundary (483 + 35) HTU + TU – crossing tens and hundreds boundary (488 +47) HTU + HTU – crossing tens boundary (368 + 123) HTU + HTU - crossing tens and hundreds boundary (387 +477)	U - U below 10 (5 - 4) TU – U below 20; not crossing tens boundary (15 - 4) TU - U crossing tens boundary (15 – 8; 35 - 8) TU - TU within tens boundary (37 - 14) TU - TU crossing tens boundary (46 – 28) TU - TU crossing hundreds boundary (105 - 17) HTU - TU within tens boundary (138 - 25) HTU - TU crossing tens boundary (265 - 58) HTU - TU crossing hundreds and tens boundary (265 – 78) HTU - HTU not crossing tens boundary (365 - 123) HTU - HTU crossing tens and hundreds boundary (414 -126) Continue as above with numbers that are 4 digits or over.	<u>Short Multiplication</u> Numbers that are 2 digits or over multiplied by U (34 x 7; 237 x 6; 5673 x 8 etc.) Numbers that have up to 2 decimal places multiplied by U (34.7 x 6; 65.24 x 8 etc.) <u>Long Multiplication</u> Numbers over 2 digits multiplied by TU (34 x 45; 456 x 23; 5643 x 34 etc.) Numbers that have up to 2 decimal places (4.7 x 16; 15.24 x 28 etc.)	<u>Short Division</u> Numbers that are 2 digits, or over, divided by U with or without remainders (78 ÷ 6; 126 ÷ 7; 674 ÷ 8; 5642 ÷ 3 etc.) Numbers that have up to 2 decimal places divided by U (34.2 ÷ 6; 65.28 ÷ 8 etc.) <u>Long Division</u> Numbers that are 3 digits or over divided by TU with or without remainders (245 ÷ 21; 3654 ÷ 35 etc.)
Introduce decimal numbers where appropriate (see policy). • Add numbers with same decimal places • Add numbers with different decimal places	Introduce decimal numbers where appropriate (see policy). • Subtract numbers with same decimal places • Subtract numbers with different decimal places		

ADDITION AND SUBTRACTION Appendix 3

Year 4

Number Facts

- **recall** addition and subtraction facts to 20 fluently (Year 1).
- **recall** number pairs that **total 100** (Year 2).
- **Recall number pairs** that **total 1000** (multiples of 100) (Year3).

Counting

- **count** backwards through zero to **include negative numbers**.
- **count in multiples** of 6, 7, 9, 25 and 1 000.
- **find 1000 more or less** than a given number

Mental Calculations

- **Consolidate**:
  HTU + 1; HTU + 10; HTU + 100; HTU – 1; HTU -10; HTU - 100
- **Use known facts to and derive related facts up to 1000** including:
  - If 7 + 5 = 12 then 397 + 5 = 402 (crossing 100s boundary)
  - If 95 + 10 = 105 then 95 + 9 = 104 (crossing 100s boundary)
  - If 205 – 10 = 195 then 205 – 9 = 196 (crossing 100s boundary)
- **Use knowledge of doubles** to derive related facts:
  - o 23 + 24 = 47 because 23 + 23 = 46 and 46 + 1= 47
- **Find the difference** between two numbers that are close to each other by counting on/ using knowledge of **inverse**:
  E.g. What is 67 -58?
  67 – 58 = 9 because 58 + 9 = 67
- Use **knowledge of inverse** to find **missing numbers**.
- **Round** to **nearest pound** and **compensate**:
  £3.99 + £3.99 = £4 + £4 – 2p = £7.98
- **Add fractions**, of the **same denominator**, when the answer will be greater than 1 (a mixed number).
- **Subtract** a fraction from 1.

Comparing Numbers

- **order and compare numbers** beyond 1000.
- compare numbers with the same number of **decimal places up to two decimal places** (copied from Fractions).
- Use strips of paper to **show equivalent fractions**.

Written Calculations

- add and subtract numbers **with up to 4 digits** using the **formal written methods of columnar addition and expanded column subtraction where appropriate.**

Identifying, Representing and Estimating Numbers

- **identify**, **represent** and **estimate** numbers using different representations.
- **Investigate fractions greater than 1.**

Inverse Operations, Estimating and Checking Answers

- **estimate** and use **inverse** operations to **check answers** to a calculation.

Reading and Writing Numbers

- **read Roman numerals to 100** (I to C) and know that over time, the numeral system changed to include the concept of zero and place value.

Problem Solving

- solve addition and subtraction **two-step problems in contexts,** deciding which operations and methods to use and why

Understanding Place Value

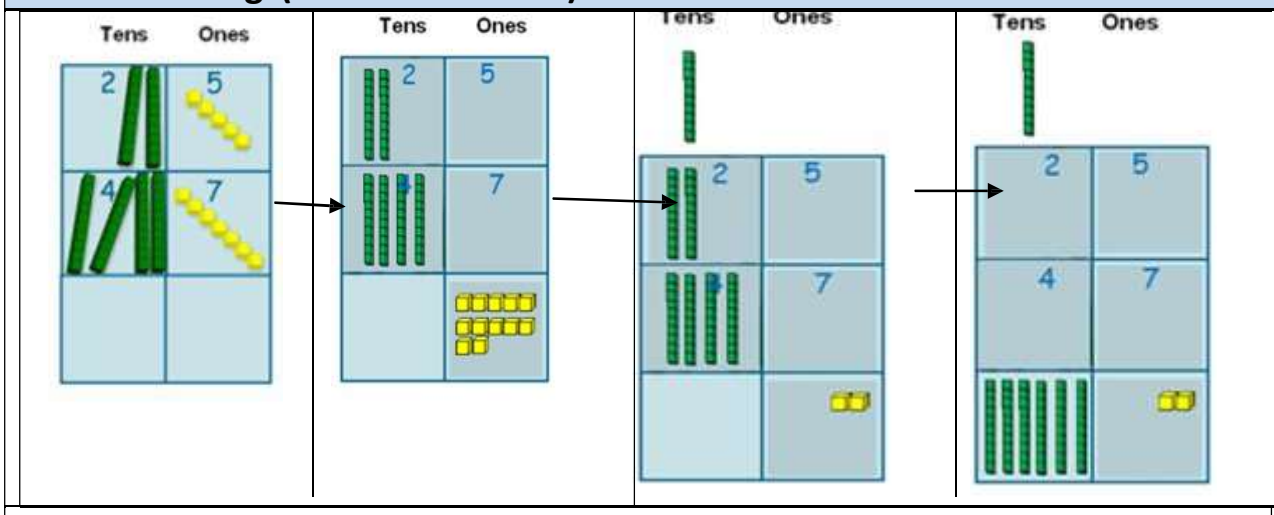
- **recognise** the place value of each digit in a **four-digit** number (thousands, hundreds, tens, and ones)
- find the effect of **dividing a one- or two-digit number by 10 and 100**, identifying the value of the digits in the answer as units, tenths and hundredths (copied from Fractions).

Rounding

- **round** any number to the **nearest 10, 100 or 1000**.
- **round decimals** with one decimal place to the **nearest whole number** (copied from Fractions).

ADDITION – Year 4

Children continue to learn from concrete resources and other models and images to develop conceptual understanding. (See Years 1 and 2)



Children use Diennes in a vertical format, to prepare them for column addition.

Column Addition with up to 4 digit numbers:

347 + 122

Estimation: 350 + 100 = 450

$$\begin{array}{r} 347 \\ +122 \\ \hline 469 \end{array}$$

THEN, with "carrying":

159 + 264 =

Estimation: 150 + 300 = 450

$$\begin{array}{r} {\scriptstyle 1} \\ 159 \\ +\ 264 \\ \hline 423 \end{array}$$

3517 + 396 =

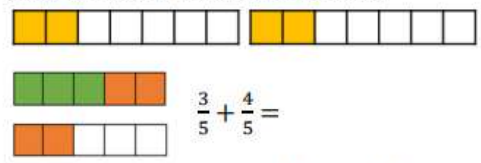
Estimation: 3500 + 400 = 3900

$$\begin{array}{r} {\scriptstyle 1\ 1} \\ 3517 \\ +\ 396 \\ \hline 3913 \end{array}$$

Use and apply this method in the context of money and measures as well.

Fractions:

Use the models to add the fractions:



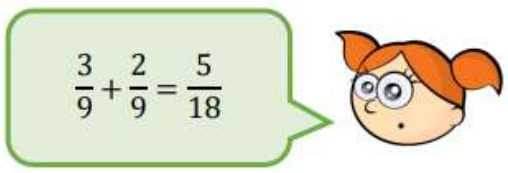
$\frac{2}{7}+\frac{2}{7}=$

$\frac{3}{5}+\frac{4}{5}=$

Choose your preferred model to add:

$\frac{2}{5}+\frac{1}{5}$ $\frac{3}{7}+\frac{6}{7}$ $\frac{7}{9}+\frac{4}{9}$

Alex is adding fractions.



Is she correct? Explain why.

How many different ways can you find to solve the calculation?

$\square + \square = \frac{11}{9}$

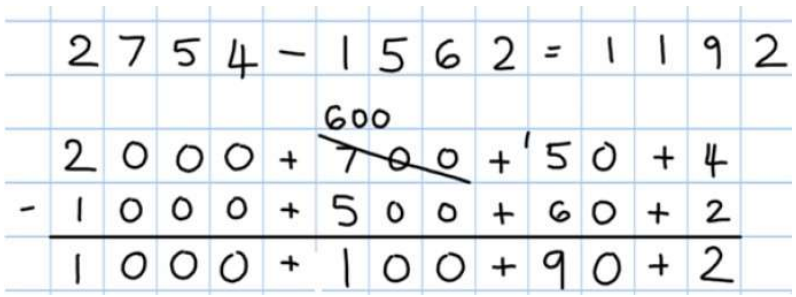
SUBTRACTION - Year 4

Children continue to learn from concrete resources and other models and images to develop conceptual understanding. (See Years 1 and 2)

Continue **expanded** subtraction method with up to 4 digit numbers:

Children begin to estimate their answers: 2754 – 1562 =

Estimation - 2800 – 1500 = 1300



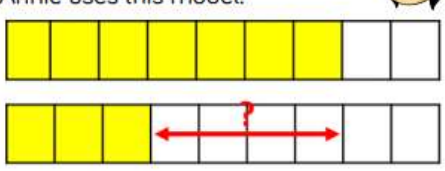
Use and apply this method in the context of money and measures as well.

Fractions:

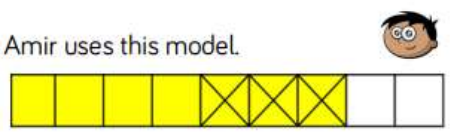
Annie and Amir are working out the answer to this problem.

$\frac{7}{9}-\frac{3}{9}$

Annie uses this model.



Amir uses this model.



Which model is correct? Explain why.

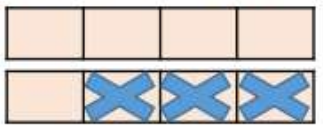
Can you write a number story for each model?

How many different ways can you find to solve the calculation?

$\square - \frac{3}{7} = \square + \square$

$\square - \frac{3}{7} = \square - \square$

Jack uses a bar model to subtract fractions.

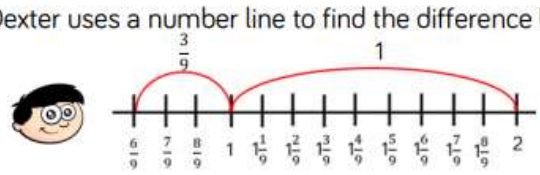


$2-\frac{3}{4}=\frac{8}{4}-\frac{3}{4}=\frac{5}{4}=1\frac{1}{4}$

Use Jack's method to calculate.

$3-\frac{3}{4}=$ $3-\frac{3}{8}=$ $3-\frac{7}{8}=$ $3-\frac{15}{8}=$

Dexter uses a number line to find the difference between 2 and $\frac{6}{9}$

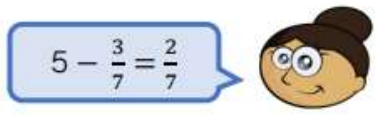


$2-\frac{6}{9}=1\frac{3}{9}$

Use a number line to find the difference between:

2 and $\frac{2}{3}$ 2 and $\frac{2}{5}$ $\frac{2}{5}$ and 4

Dora is subtracting a fraction from a whole.



Can you spot her mistake?

What should the answer be?

ADDITION AND SUBTRACTION Appendix 4

Year 5

Number Facts

- recall addition and subtraction **facts to 20** fluently (Year 1).
- number pairs that **total 100** (Year 2).
- number pairs that **total 1000** (multiples of 100) (Year 3).
- number **pairs that total 1000** (multiples of 10).

Counting

- interpret **negative** numbers in context, count forwards and backwards **with positive and negative whole numbers**, including **through zero**.
- **count** forwards or backwards **in steps of powers of 10** for any given number up to 1 000 000.

Mental Calculations

- add and subtract numbers **mentally** with increasingly large numbers **and consolidate from previous years including missing number questions.**
- **add decimals**, with the same or a different number of decimal places, knowledge of whole numbers: 6.5+2.7=9.2 because 65+27=92
- **subtract decimals**, with the **same** number of decimal places, knowledge of whole numbers: 6.5-2.7=3.8 because 65-27=38
- **round to nearest pound** and **compensate**: £3.98 + £3.98 + £3.98 = £4 + £4 + £4 – 6p = £11.94
- add **three** or **more fractions**.
- **add and subtract fractions** which have **different denominators**.
- **add and subtract mixed numbers**.

Comparing Numbers

- **read, write, order and compare numbers to at least 1,000,000** and determine the value of each digit (appears also in Reading and Writing Numbers).
- Compare & order **positive & negative** numbers
- Compare **decimal** numbers **with different numbers of decimal places.**
- **Compare** & **order fractions less than 1**.
- **Compare** and **order** fractions greater than 1.
- **Convert improper fractions to mixed numbers** & **vice versa.**

Written Calculations

- add and subtract whole numbers **with more than 4 digits**, including using **formal written methods** (columnar addition and subtraction).
- **add decimals**, with the same or a different number of decimal places, knowledge of whole numbers:
- **subtract decimals**, with the **same** number of decimal places, knowledge of whole numbers.

Identifying, Representing and Estimating

- Consolidate work from before.
- Can identify & write **improper** fractions and **mixed numbers** (such as 16/5 or 3 1/5).

Inverse Operations, Estimating and Checking Answers

- use **rounding** to check answers to calculations and determine, in the context of a problem, levels of **accuracy**.
- As before, **use the inverse** to **check** own answers where appropriate.
- Use **different methods**, of the same operation, to check own answers or that of a peer.

Reading and Writing Numbers

- **read, write, order and compare numbers to at least 1,000,000** and determine the value of each digit.
- **read Roman numerals to 1000 (**M) and **recognise years** written in Roman numerals.
- Can identify & write improper fractions and mixed numbers.

Problem Solving

- solve addition and subtraction **multi-step problems** in contexts, deciding which **operations** and **methods** to use and **why**.

Understanding Place Value

- **read, write, order and compare numbers to at least 1,000,000** and determine the value of each digit (appears also in Reading and Writing Numbers).
- recognise and use **thousandths** and relate them to **tenths, hundredths and decimal equivalents**.

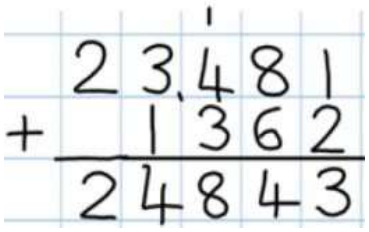
Rounding

- **round** any number up to 1 000 000 to the nearest **10, 100, 1 000, 10 000 and 100 000.**
- round **decimals with two decimal places** to the **nearest whole number** and to **one decimal place**.

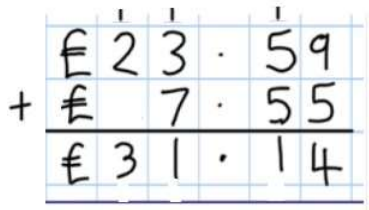
ADDITION - Year 5

Children continue to learn from concrete resources and other models and images to develop conceptual understanding. (See Years 1 and 2)

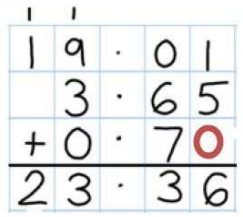
Numbers exceeding 4 digits:
23,481 + 1362 =
Estimation: 24,000 + 1000 = 25,000



Same number of decimal places:
£23.59 + £7.55 =
Estimation: £24 + £8 = £32



Then, different number of decimal places:
19.01 + 3.65 + 0.7 =
Estimation: 20 + 4 + 1 = 25



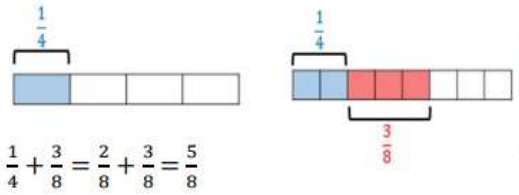
Use and apply this method in the context of money and measures as well.

Fractions:

How many different ways can you balance the equation?

$$\frac{5}{9} + \square = \frac{8}{9} + \square$$

Rosie is using a bar model to solve $\frac{1}{4} + \frac{3}{8}$



$\frac{1}{4} + \frac{3}{8} = \frac{2}{8} + \frac{3}{8} = \frac{5}{8}$

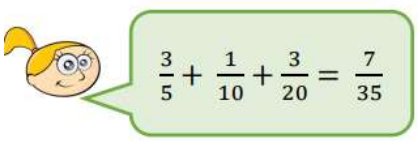
Jack has added 3 fractions together to get an answer of $\frac{17}{18}$

What 3 fractions could he have added?

Can you find more than one answer?

Eva is attempting to answer:

$$\frac{3}{5} + \frac{1}{10} + \frac{3}{20}$$

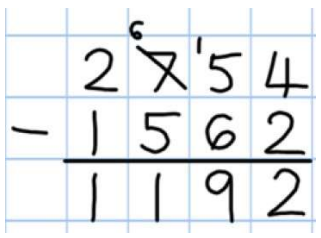


Do you agree with Eva?
Explain why.

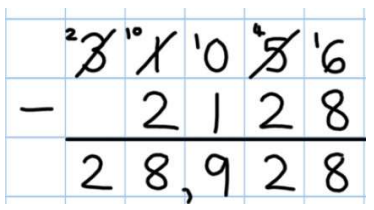
SUBTRACTION - Year 5

Children continue to learn from concrete resources and other models and images to develop conceptual understanding. (See Years 1 and 2)

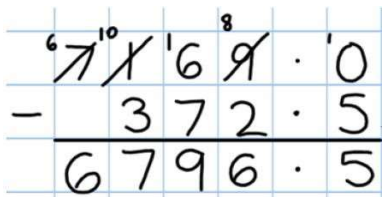
Decomposition method:
2754 – 1532 =
Estimation: 2800 - 1500 = 1300



Decomposition method:
Increase in complexity:
31,056 – 2,128 =
Estimation: 31,000 – 2000 = 29,000



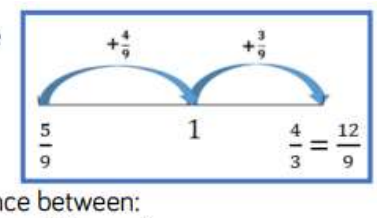
Decomposition method: Begin to use decimals:
7169 – 372.5 =
Estimation: 7000 – 400 = 6600



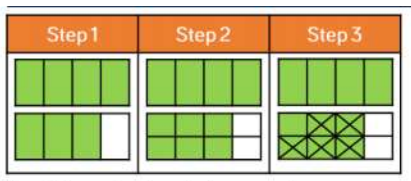
Use and apply this method in the context of money and measures as well.

Fractions:

Amir uses a number line to find the difference between $\frac{5}{9}$ and $\frac{4}{3}$



Use this method to find the difference between:
$\frac{3}{4}$ and $\frac{5}{12}$ $\frac{19}{15}$ and $\frac{3}{5}$ $\frac{20}{9}$ and $\frac{4}{3}$



$1\frac{3}{4} - \frac{5}{8} = 1\frac{1}{8}$

Use this method to help you solve:
$2\frac{3}{5} - \frac{3}{10}$ $1\frac{2}{3} - \frac{1}{6}$ $1\frac{5}{6} - \frac{7}{12}$

Which subtraction is the odd one out?

A $\frac{13}{4} - \frac{3}{8}$

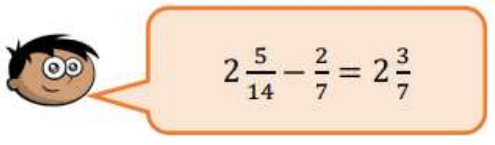
B $\frac{10}{3} - \frac{2}{9}$

C $\frac{23}{7} - \frac{1}{3}$

Explain why.

Amir is attempting to solve $2\frac{5}{14} - \frac{2}{7}$

Here is his working out:



Do you agree with Amir?
Explain your answer.

ADDITION AND SUBTRACTION Appendix 5	
Year 6	
Number Bonds	**Counting**
• Consolidate all number bonds work from previous years.	• use **negative** numbers in context, and calculate intervals across zero.
Mental Calculations	**Comparing Numbers**
• perform mental calculations, including with **mixed operations** and **large** numbers. • use their knowledge of **the order of operations** (**BODMAS**) to carry out calculations involving the four operations o (4 x 3) ÷ 6 + 50 = ? • **Consolidate** all previous adding and subtracting of fractions' work. • **Add and subtract mixed** numbers.	• read, write, order and compare numbers up **to 10, 000,000 and** determine the value of each digit. • **Ordering** fractions by placing them on a **number line**. • **Reducing** fractions to their **simplest** form. • **Recognizing** a **rule** in a **sequence** of **fractions** & continuing the sequence or put in the missing numbers. • **Consolidate** all **comparing/ordering** of fractions.
Written Calculations	**Identifying, Representing and Estimating Numbers**
• **Consolidate year** 5, with increasing complexity of numbers.	
Inverse Operations, Estimating and Checking Answers	**Reading and Writing Numbers**
• use **estimation / the inverse/ different methods** to check answers to calculations and determine, in the context of a problem, levels of accuracy.	• **read, write, order and compare numbers up to 10,000,000** and determine the value of each digit
Problem Solving	**Understanding Place Value**
• solve addition and subtraction **multi-step** problems in contexts, deciding **which operations and methods** to use and **why**.	• **read, write, order and compare numbers up to 10,000,000** and determine the value of each digit. • identify the **value of each digit to three decimal places and multiply and divide numbers by 10, 100 and 1000** where the answers are up to three decimal places.
	Rounding
	• **round** any whole number, or **decimal to 3 decimal places**, to a required degree of accuracy. • solve problems which require **answers** to be **rounded to specified degrees** of **accuracy**.

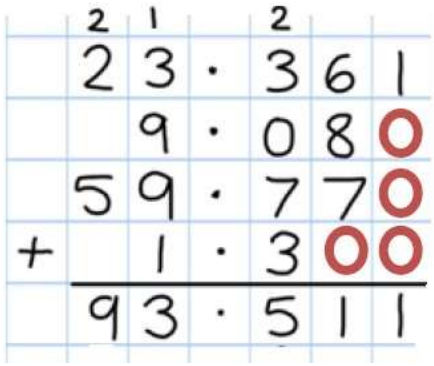
ADDITION – Year 6

Children continue to learn from concrete resources and other models and images to develop conceptual understanding. (See Years 1 and 2)

Adding **several** numbers of increasing complexity:

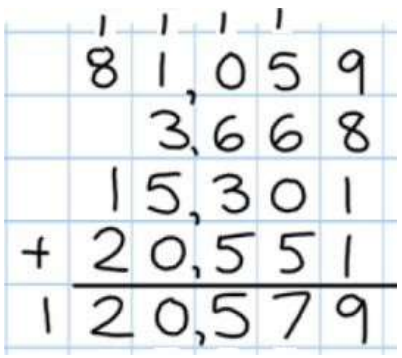
23.361 + 9.08 + 59.77 + 1.3 =

Estimation: 25 + 10 + 60 + 1 = 96



81,059 + 3668+ 15,301 + 20,551 =

Estimation: 80,000 + 5000 + 15,000 + 20,000 = 120,000



Use and apply this method in the context of money and measures as well.

Fractions:

Whitney is calculating $\frac{5}{8} + \frac{3}{16}$

She finds the lowest common multiple of 8 and 16 to find a common denominator.

LCM of 8 and 16 is 16 $\frac{5}{8} = \frac{10}{16}$ $\frac{10}{16} + \frac{3}{16} = \frac{13}{16}$

Use this method to calculate:

$\frac{1}{3} + \frac{2}{9} =$ $\frac{3}{7} + \frac{7}{21} =$ $\frac{8}{15} + \frac{1}{5} =$ $\frac{3}{16} + \frac{3}{8} + \frac{1}{4} =$

Use the same digit in both boxes to complete the calculation.

Is there more than one way to do it?

$$\frac{\square}{20} + \frac{1}{\square} = \frac{9}{20}$$

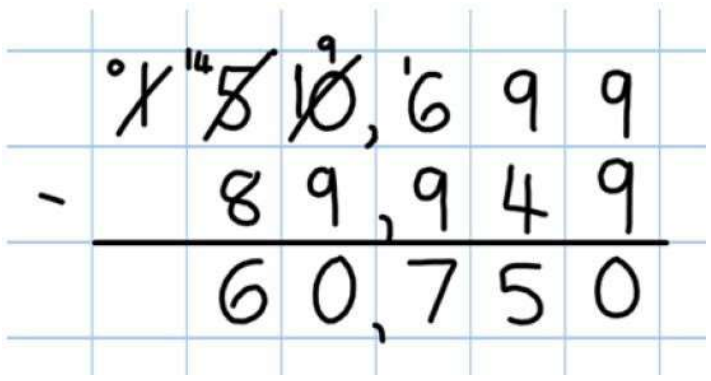
Fill in the boxes to make the calculation correct.

$$1\frac{\square}{10} = \frac{3}{\square} + \frac{\square}{10}$$

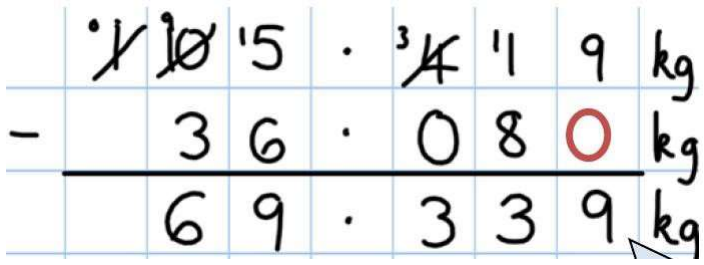
SUBTRACTION – Year 6

Children continue to learn from concrete resources and other models and images to develop conceptual understanding. (See Years 1 and 2)

Decomposition method with increasing complexity:



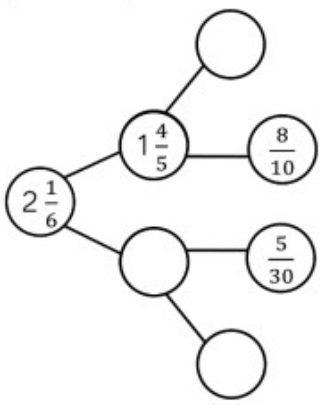
Decomposition method with different decimal places:



Use and apply this method in the context of money and measures as well.

Fractions:

Complete the part-whole model.



Alex has 5 bags of sweets.

On Monday she eats $\frac{2}{3}$ of a bag and gives $\frac{4}{5}$ of a bag to her friend.

On Tuesday she eats $1\frac{1}{3}$ bags and gives $\frac{2}{5}$ of a bag to her friend.

What fraction of her sweets does Alex have left?

Give your answer in its simplest form.

3 children are working out $6\frac{2}{3} - \frac{5}{6}$

They partition the mixed number in the following ways to help them.

Dora $5 + 1\frac{2}{3} - \frac{5}{6}$

Alex $5 + 1\frac{4}{6} - \frac{5}{6}$

Jack $5 + \frac{10}{6} - \frac{5}{6}$

Are they all correct?
Which method do you prefer?
Explain why.

MULTIPLICATION AND DIVISION Appendix 6

Year 4

Multiplication and Division facts

- **count** in multiples of **6, 7, 9, 25 and 1000** (copied from Number and Place Value).
- recall multiplication and division facts for multiplication tables up to **12 × 12**.
- **Doubles** and **halves** of numbers up to 50.

Mental Calculations

- use place value, known and derived facts to **multiply and divide mentally**, including: **multiplying by 0 and 1; dividing by 1; multiplying together three numbers.**
- Recognise, and use, **factor pairs** and commutativity in mental calculations (appears also in Properties of Numbers).
- Understand the impact on place value when a number is **multiplied or divided by 10 and 100**
- Halve whole numbers **including odd numbers**.
- Consolidate that x 4 is doubling twice and **introduce x8** is **doubling three** times & ÷ 4 is ÷2 twice, ÷8 is ÷2 three times.

Written Calculations

- Multiply TU and HTU by a U **using grid method.**
- Multiply HTU x U using **the grid method** then moving into **formal written methods.**

Properties of Numbers – Multiples, Factors, Primes, Square and Cube numbers

- Recognise and use **factor pairs** and commutativity in mental calculations (repeated).

Inverse Operations, Estimating and Checking

- **Estimate** and use **inverse operations** to check answers to a calculation.

Problem Solving

- solve problems involving **multiplying and adding**, including using the distributive law to multiply two digit numbers by one digit, integer scaling problems and harder correspondence problems such as n objects are connected to m objects.
- Solve **area** problems about **rectangles**.

MULTIPLICATION - Year 4

Children continue to learn from concrete resources and other models and images to develop conceptual understanding. (See Years 1 and 2)

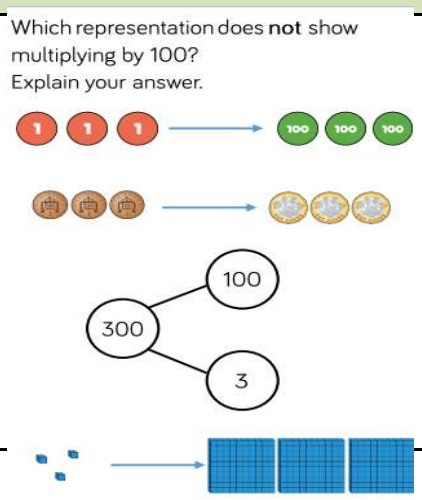
- Children know that the digits move to the left when a number is **multiplied by 10 and 100**

3 × ▪ = ▪▪▪ = 3 ones = 3

Complete:

3 × ▮ = ▮▮▮ = ___ tens = ___

3 × ▦ = ▦▦▦ = ___ hundreds = ___



Children use mental strategies to find **products** and **missing** numbers.

Use your knowledge of the 6 times table to complete the missing values?

6 × 2 = ___	___ × 6 = 12	6 × 2 × 10 = ___
___ × 20 = 120	20 × ___ = 120	6 × 2 × ___ = 1,200
6 × ___ = 1,200	200 × 6 = ___	10 × ___ × 6 = 120

I am thinking of 2 numbers where the sum of the numbers is 15 and the product is 54

What are my numbers?

Think of your own problem for a friend to solve?

Children use mental methods to multiply **three** one-digit numbers together using the "associate law"(it doesn't matter how we group the numbers).

Choose three digit cards.
Arrange them in the calculation.

□ × □ × □ = □

How many different calculations can you make using your three digit cards?
Which order do you find it the most efficient to calculate the product?
How have you grouped the numbers?

Make the target number of 84 using three of the digits below.

7	5	3	4	6	2

□ × □ × □ = 84

Multiply the remaining three digits together, what is the product of the three numbers?

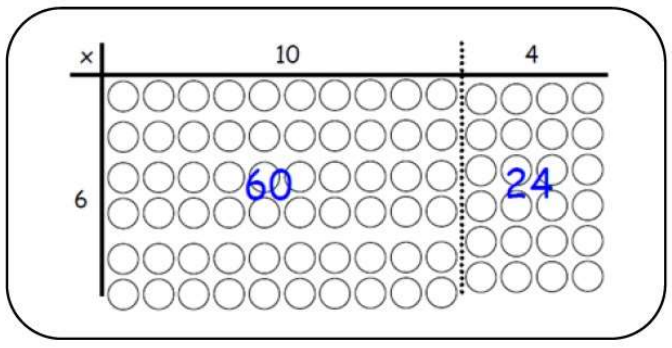
Is the product smaller or larger than 84?

Can you complete this problem in more than one way?

Children then move on to using grid method for multiplying two and three-digit numbers by one

14 x 6=
Estimation: 10 x 6 = 60

Link the layout of the grid to an array initially:



x	10	4
6	60	24

60 + 24 = 84

234 x 6
Estimation: 200 x 6 = 1200

200 + 180 + 24 = 1404 using column addition if necessary

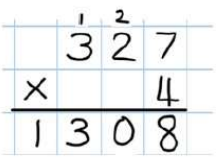
x	200	30	4
6	1200	180	24

1200
180
24
1404

Short multiplication for multiplying by a single digit

x	300	20	7
4	1200	80	28

1
1200
80
28
1308



DIVISION – Year 4

Children continue to learn from concrete resources and other models and images to develop conceptual understanding. (See Years 1 and 2)

Children use mental strategies to find **products** and **missing** numbers.

Children know that the digits move to the **right** when a number is **divided by 10 and 100.**

Eva and Whitney are dividing numbers by 10 and 100
They both start with the same 4-digit number.

They give some clues about their answer.

Eva

My answer has 8 ones and 2 tens.

My answer has 2 hundreds, 8 tens and 0 ones.

Whitney

What number did they both start with?
Who divided by what?

Use <, > or = to make each statement correct.

3,600 ÷ 10	◯	3,600 ÷ 100
2,700 ÷ 100	◯	270 ÷ 10
4,200 ÷ 100	◯	430 ÷ 10

Use the digit cards to fill in the missing digits.

1	2	3	4	5	6	7	8	9

170 ÷ 10 = __

_20 × 10 = 3,_00

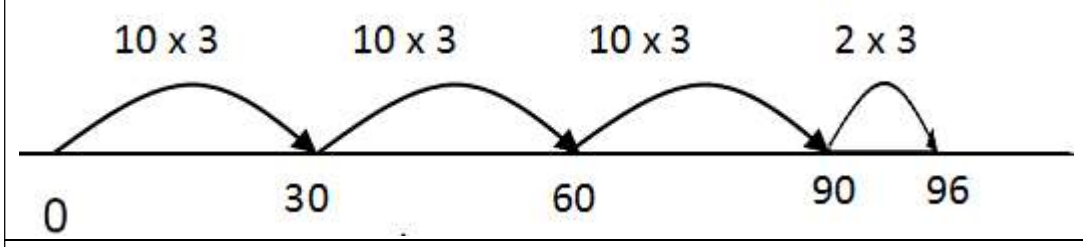
1,8_0 ÷ 10 = 1_6

_9 × 100 = 5,_00

6_ = 6,400 ÷ 100

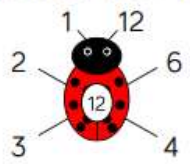
Children begin to **chunk** on a **number line**: (2 or 3 digit number by a 1 digit number)

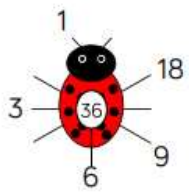
96 ÷ 3 = 32



Children learn that a **factor** is a number which **divides** into another perfectly and can identify factor pairs which, when multiplied together, make the target number.

Here is an example of a factor bug for 12
Complete the factor bug for 36





Are all the factors in pairs?
Draw your own factor bugs for 16, 48, 56 and 35

Tommy says

The greater the number, the more factors it will have.

Is Tommy correct?

Use arrays to explain your answer.

How many other numbers can you find that are equal to the sum of their factors?
Which numbers are less than the sum of their factors?
Which numbers are greater than the sum of their factors?

Fractions:

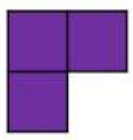
Children **find fractions** of amounts, when the **numerator is greater than 1** and apply this to more complex problems.

The school kitchen needs to buy carrots for lunch.
A large bag has 200 carrots and a medium bag has $\frac{3}{5}$ of a large bag.
Mrs Rose says,

I need 150 carrots so I will have to buy a large bag.

Is Mrs Rose correct?
Explain your reasoning.

These three squares are $\frac{1}{4}$ of a whole shape.



How many different shapes can you draw that could be the complete shape?

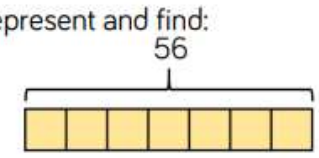
True or False?

To find $\frac{3}{8}$ of a number, divide by 3 and multiply by 8

Convince me.

Use a bar model to help you represent and find:

$\frac{1}{7}$ of 56 = 56 ÷ ☐



$\frac{2}{7}$ of 56 $\frac{3}{7}$ of 56 $\frac{4}{7}$ of 56 $\frac{4}{7}$ of 28 $\frac{7}{7}$ of 28

Jack has a bottle of lemonade.
He has one-fifth left in the bottle.
There are 150 ml left.
How much lemonade was in the bottle when it was full?

MULTIPLICATION AND DIVISION Appendix 7

Year 5

Multiplication and Division facts

- count forwards or backwards in steps of powers of 10 for any given number up to 1,000,000 (copied from Number and Place Value)

Mental Calculations

- multiply and divide numbers mentally drawing upon **known facts- including decimals**:
  - 0.6 x 7 = 4.2 because 6 x 7 = 42
  - 3.5 ÷ 5 = 0.7 because 35 ÷ 5 = 7
- **multiply and divide** whole numbers, and those involving decimals ,**by 10, 100 and 1000.**
- Know that **TU x 5** is TU x 10 and **then halved**. (18 x 5 = (18 x 10) ÷ 2)
- Know that **TU x 9** is TU x 10 then subtract TU (18 x 9 = (18 x 10) – 18 = 162)
- **Round and compensate** for near pounds (£4.99 x 3 = £5 x 3 – 3p = £14.97)
- Use knowledge of **doubles** and **halves** of whole numbers to find doubles and halves of decimal numbers (2.3 + 2.3 = 4.6 because 23+23=46; Half of 5.8 is 2.7 because half of 58 is 27).
- Use times tables/ knowledge of **factors** and **multiples** to find **equivalent** fractions.
- Use multiplication and division knowledge to **convert improper fractions to mixed numbers and vice versa.**
- **Multiply** a **fraction** by a **whole number** (integer).
- consolidate **fractions of amounts** from year 4 using bar models and pictures as well as numerically.

Written Calculations

- multiply numbers up to 4 **digits by a one- or two-digit number** using **grid method then expanded form**.
- divide numbers up to **4 digits by a one-digit number** using the formal written method of short division **(bus stop)** and interpret remainders appropriately for the context.
- Long division using a **number line and chunking then chunking** but writing this vertically.

Properties of Numbers – Multiples, Factors, Primes, Square and Cube numbers

- identify **multiples and factors**, including finding all **factor pairs** of a number, and **common factors** of two numbers.
- know and use the vocabulary of **prime numbers**, prime factors and composite (non-prime) numbers.
- establish whether a number up to 100 is prime and recall prime numbers up to 19.
- recognise and use **square numbers and cube numbers**, and the notation for squared (2) and cubed (3.)

Inverse Operations, Estimating and Checking

- estimate and use inverse operations to check answers to a calculation

Problem Solving

- solve problems involving multiplication and division including using their knowledge of f**actors and multiples, squares and cubes**.
- solve problems involving addition, subtraction, multiplication and division **and a combination** of these, including understanding the meaning of the equals sign.
- solve **problems** involving multiplication and division, **including scaling** by simple fractions and problems involving simple exchange rates.
- Solve **area** problems of **compound rectangular** shapes.

MULTIPLICATION - Year 5

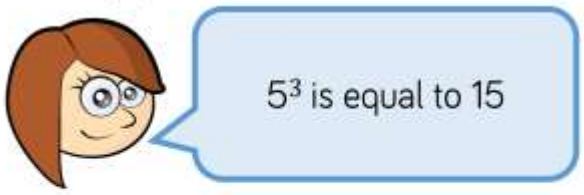
Children continue to learn from concrete resources and other models and images to develop conceptual understanding. (See Years 1 and 2)

Factors, Squares, Cubes and Primes:

Always, Sometimes, Never

A square number has an even number of factors.

Rosie says,



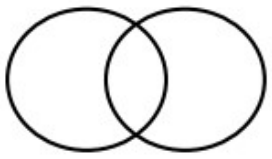
Do you agree?
Explain your answer.

Dora says all prime numbers have to be odd.

Her friend Amir says that means all odd numbers are prime, so 9, 27 and 45 are prime numbers.

Explain Amir's and Dora's mistakes and correct them.

Fill in the Venn diagram to show the factors of 20 and 24



Where are the common factors of 20 and 24?
Use a Venn diagram to show the common factors of 9 and 15

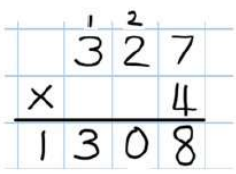
Children use mental strategies to find products and missing numbers.
Children **practise** using grid method for multiplying two and three digit numbers by one number as Year 4

Short Multiplication:
Use grid method to lead on to short multiplication.
Children need to see the continuity in method and appreciate its efficiency.
327 x 4 =
Estimation: 300 x 4 = 1200

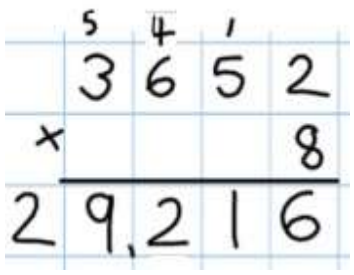
Short multiplication for multiplying by a single digit

x	300	20	7
4	1200	80	28

1
1200
80
28
1308



Leading on to 4 digit numbers:
3652 x 8 =
Estimation: 4000 x 8 = 32,000

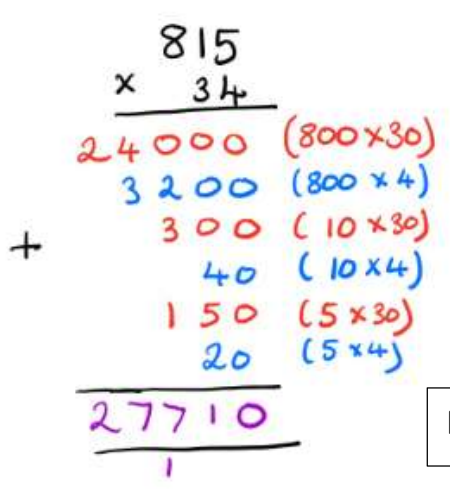


Long Multiplication: Use the **grid method** to consolidate from year 4. Then move into the **expanded** form.

815 x 34 We partition 815 into 800 and 10 and 5 and put it in a table.
We partition 34 into 30 and 4 and put it in the table.

x	800	10	5
30	24000	300	150
4	3200	40	20

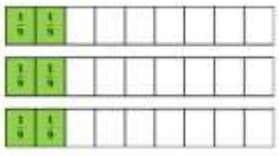
Multiply the numbers in the grid one by one, then add all the numbers to make 27,710.



Fractions:

Use and apply this method in the context of money and measures as well.

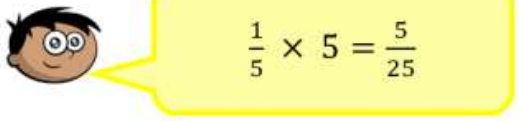
Count the number of ninths to work out $3 \times \frac{2}{9}$



Use this method to work out:

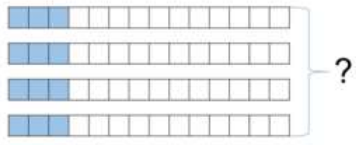
$\frac{3}{8} \times 2$ $\frac{5}{16} \times 3$ $4 \times \frac{2}{11}$

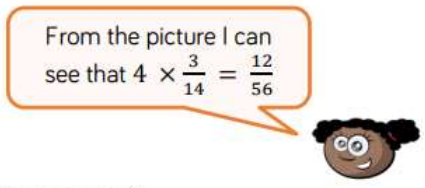
Amir is multiplying fractions by a whole number.



Can you explain his mistake?

Whitney has calculated $4 \times \frac{3}{14}$





Do you agree?

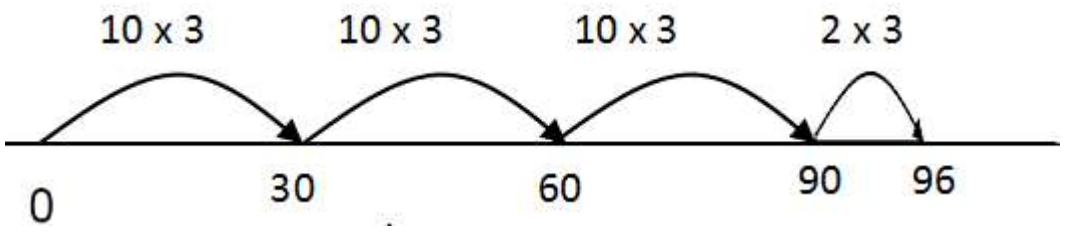
Explain why.

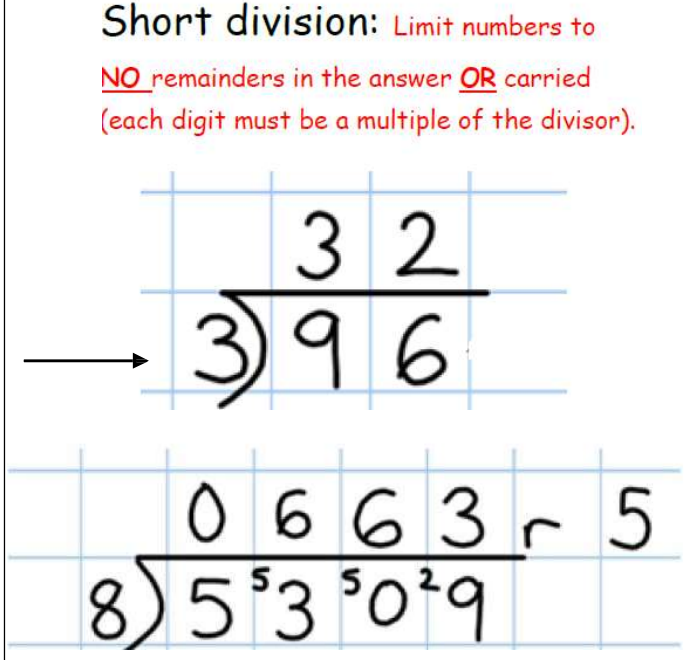
DIVISION – Year 5

Children continue to learn from concrete resources and other models and images to develop conceptual understanding. (See Years 1 and 2)

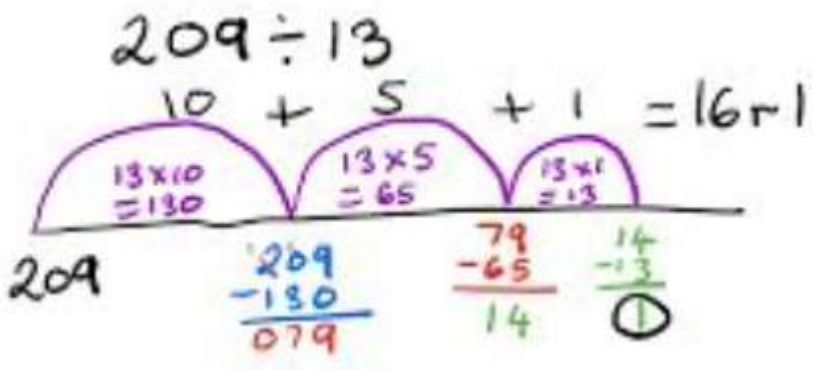
Children use short division (bus stop method) to calculate 2 and 3 digit numbers with1 digit number

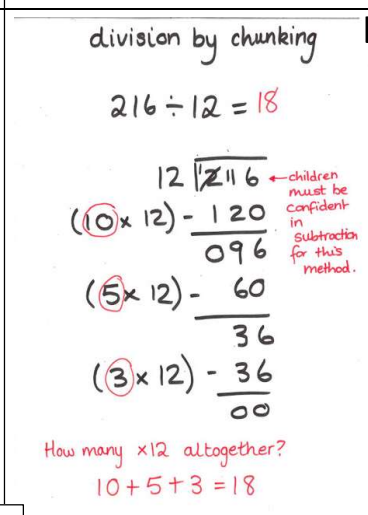
Children see the link between **chunking** on a number line with short division:
96 ÷ 3 = 32





Long Division: Chunking & subtraction



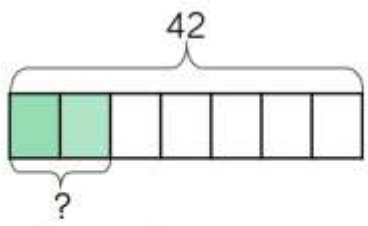


Long division, writing this after they've got used to the number line.

Fractions:

Find Fractions of Amounts:

Find $\frac{2}{7}$ of 42



$42 \div 7 = 6$
$6 \times 2 = 12$
$\frac{2}{7}$ of 42 is 12

Use this method to find:

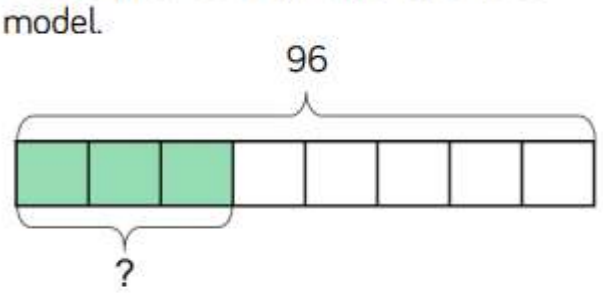
$\frac{3}{8}$ of 56 $\frac{5}{6}$ of 480 $\frac{4}{9}$ of 81 m

$\frac{7}{16}$ of a class are boys.

There are 18 girls in the class.

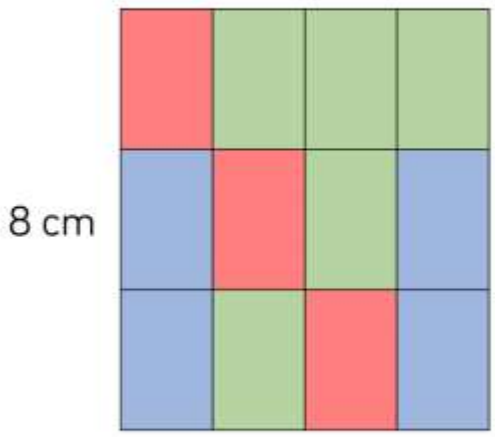
How many children are in the class?

Write a problem that matches the bar model.



What other questions could you ask from this model?

Find the area of each colour in the rectangle.



What would happen if one of the red or green rectangles was changed to a blue?

MULTIPLICATION AND DIVISION Appendix 8

Year 6

Multiplication and Division facts

- As Year 5

Mental Calculations

- perform mental calculations, including with **mixed operations** and **large** numbers.
- associate a fraction with division and calculate decimal fraction equivalents (e.g. 0.375) for a simple fraction (e.g. 3/8)
- Relate multiplication & division to **ratio**.
- **Multiply fractions** by an **integer**.
- **Multiply fractions** by **fractions**.
- **Divide fractions** by an **integer**.

Written Calculations

- multiply multi-digit numbers up to **4 digits by a two-digit whole number** using the **formal** written method of long multiplication
- **divide** numbers up to **4-digits by a one-digit** whole number using the **formal written** method of short division where appropriate for the context
- **divide** numbers up to 4 digits by a two-digit whole number using the **formal written method** of long division, and **interpret remainders** as whole number **remainders**, **fractions**, or by **rounding**, as appropriate for the context.
- use **written division methods** in cases where the answer has up to **two decimal places**.

Properties of Numbers – Multiples, Factors, Primes, Square and Cube numbers

- identify **common factors**, the **highest common factor**, **common multiples, the lowest common multiples**, **prime numbers** and **prime factors**.
- use **common factors to simplify fractions**; use common multiples to express fractions in the same denomination.
- **calculate, estimate** and compare **volume** of **cubes and cuboids** using standard units, including centimetre cubed (cm3) and cubic metres (m3), and extending to other units such as mm3 and km3.
- **Convert** between **metric and metric measurements** & between **metric & imperial measurements.**

Order of Operations

- use their knowledge of the **order of operations** to carry out calculations involving the four operations (**BODMAS**).

Inverse Operations, Estimating and Checking

- use **estimation** to check answers to calculations and determine, in the context of a problem, levels of accuracy.

Problem Solving

- solve multi-step problems involving addition, subtraction, multiplication and division
- solve problems involving similar shapes where the scale factor is known or can be found.
- Find the **area** of **compound** shapes made from **rectangles and triangles**.

MULTIPLICATION - Year 6

Children continue to learn from concrete resources and other models and images to develop conceptual understanding. (See Years 1 and 2)

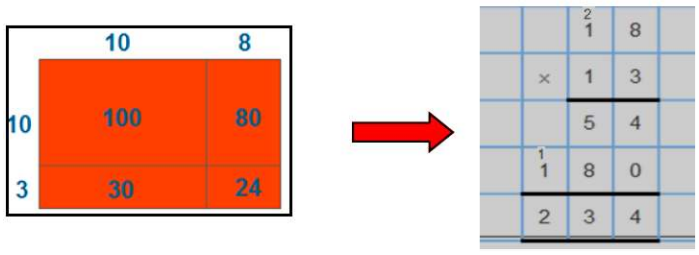
Children practise short multiplication as in Year 5.

Use grid multiplication to introduce long multiplication:

18 x 13 =

Estimation: 20 x 10 = 200

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



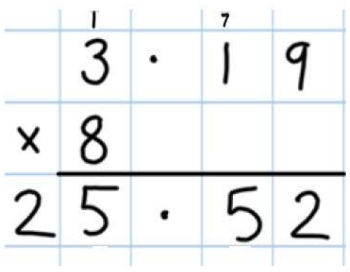
1234 x 16 =

Estimation: 1200 x 20 = 24,000

Use short and long multiplication to multiply numbers with up to **2 decimal places:**

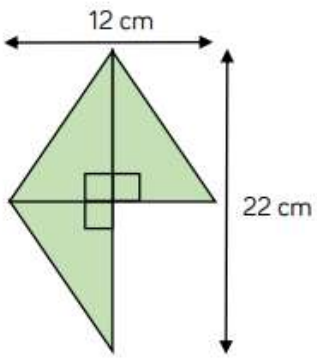
3.19 x 8 =

Estimation: 3 x 8 = 24



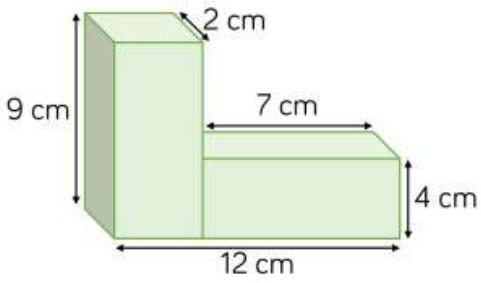
Use and apply this method in the context of money and measures as well.

The shape is made of three identical triangles.



What is the area of the shape?

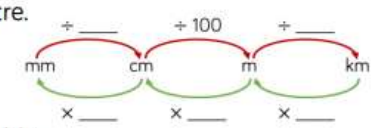
Calculate the volume of the shape.



There are ___ mm in one centimetre.

There are ___ cm in one metre.

There are ___ m in one kilometre.



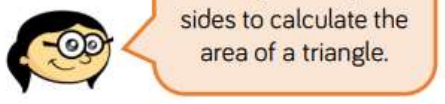
Use these facts to complete the table.

mm	cm	m	km
44,000			
	2,780		
		15.5	
			1.75

A tube of toothpaste holds 75 ml.

How many tubes can be filled using 3 litres of toothpaste?

Annie is calculating the area of a right-angled triangle.



Do you agree with Annie? Explain your answer.

Fractions:

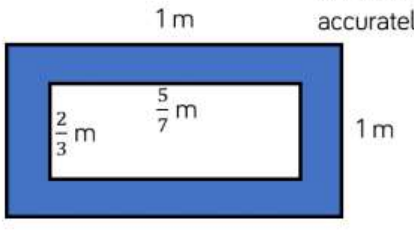
How many ways can you complete the missing digits?

$$\square \times \frac{3}{\square} = \frac{6}{12}$$

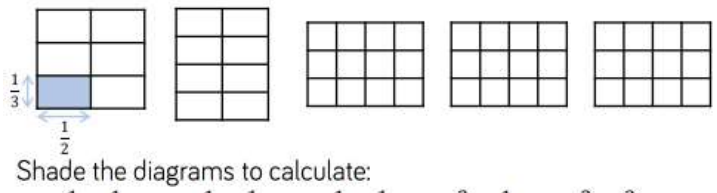
$$= \frac{\square}{2}$$

Find the area of the shaded part of the shape.

Not drawn accurately



Alex is drawing diagrams to represent multiplying fractions.



Shade the diagrams to calculate:

$\frac{1}{3} \times \frac{1}{2} =$ $\frac{1}{4} \times \frac{1}{2} =$ $\frac{1}{3} \times \frac{1}{4} =$ $\frac{2}{3} \times \frac{1}{4} =$ $\frac{2}{3} \times \frac{3}{4} =$

Write your answers in their simplest form.

Eva and Amir both work on a homework project.

Who spent the most time on their project?

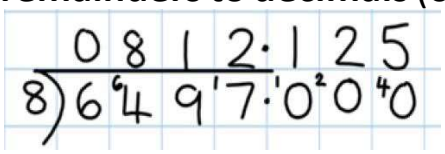
Explain your reasoning.

DIVISION – Year 6

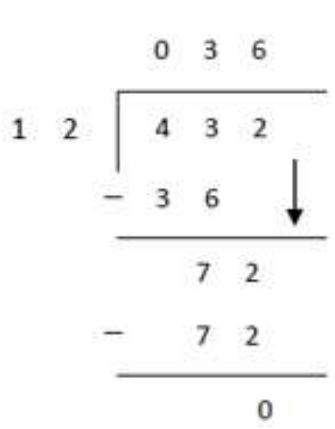
Children continue to learn from concrete resources and other models and images to develop conceptual understanding. (See Years 1 and 2)

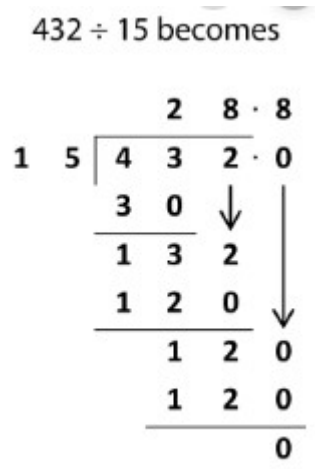
Children practise short division as in Year 5.

Extend short division to include **converting remainders to decimals** (only to those who are ready):



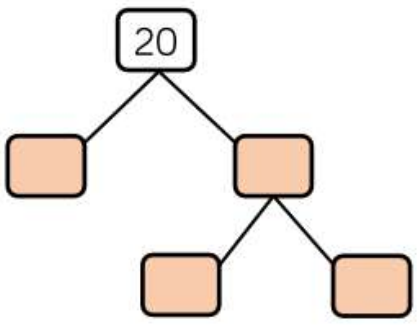
Introduce long division to those who are ready:





Factors:

All numbers can be broken down into prime factors.
A prime factor tree can help us find them.
Complete the prime factor tree for 20



Use the clues to work out the number.

- It is greater than 10
- It is an odd number
- It is not a prime number
- It is less than 25
- It is a factor of 60

Fractions: **Dividing** a Fraction by an integer.

Tommy says,

Dividing by 2 is the same as finding half of a number so $\frac{4}{11} \div 2$ is the same as $\frac{1}{2} \times \frac{4}{11}$

Do you agree?
Explain why.

Calculate the missing fractions and integers.

$\square \div 4 = \frac{7}{36}$

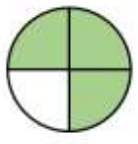
$\frac{3}{20} \div \square = \frac{3}{80}$

$\square \div \square = \frac{2}{5}$

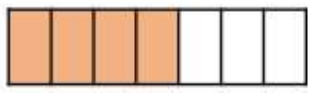
Is there more than one possibility?

Use the diagrams to help you calculate.

$\frac{3}{4} \div 3 =$



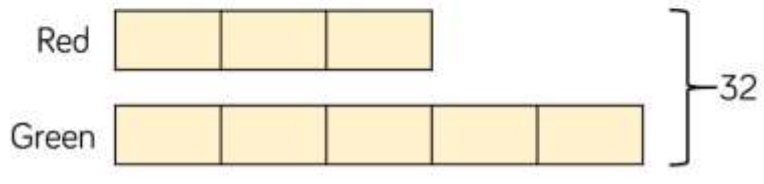
$\frac{4}{7} \div 4 =$



$\frac{4}{7} \div 2 =$

Ratio:

Eva has a packet of sweets.
For every 3 red sweets there are 5 green sweets.
If there are 32 sweets in the packet in total, how many of each colour are there?
You can use a bar model to help you.



This recipe makes 10 flapjacks.

Flapjacks

120 g butter
100 g brown sugar
4 tablespoons golden syrup
250 g oats
40 g sultanas

Amir has 180 g butter.

What is the largest number of flapjacks he can make?

How much of the other ingredients will he need?

Teddy has two packets of sweets.

In the first packet, for every one strawberry sweet there are two orange sweets.

In the second packet, for every three orange sweets there are two strawberry sweets.

Each packet contains 15 sweets in total.

Which packet has more strawberry sweets and by how many?