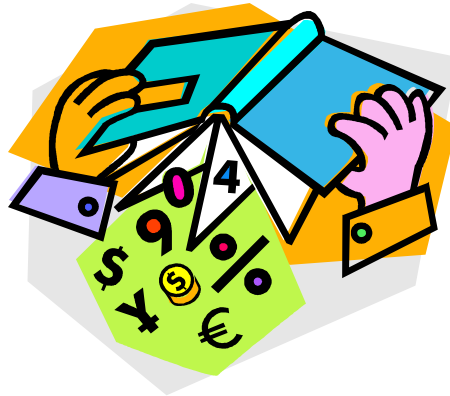


Whitley Village Primary School



Calculation Policy



Written July 2015
Review date July 2017

The Acorns Primary and Nursery School
Calculation Policy

July 2015

Aims

We aim to provide children with:

- a secure and appropriate knowledge of number facts
- a broad range of informal methods, which lead to reliable compact and efficient methods for each operation
- the confidence and ability to independently select an appropriate method for the numbers
- reliable strategies for checking the accuracy of their solutions
- an understanding of the relationships between the four operations. e.g.
 - inverses: addition/subtraction and multiplication/division
 - multiplication as repeated addition and division as repeated subtraction
 - commutative, associative and distributive laws (see appendix)

Why do we need this policy?

To ensure and provide:

- consistency in methods taught throughout the school.
- appropriate progression from informal / practical methods of recording to written methods for each of the four operations.
- an aid to parent's understanding in their child's stages of learning.

Things to remember

- Children should be introduced to a **wide range of mental strategies** for all four operations.
- Encourage children to **record their mental calculations with informal jottings**
- More **formal written methods** should follow only when the child is able to use a wide range of mental calculation strategies and informal jottings to support these. They **should not replace mental calculation**, which must continue to be taught alongside.
- Children should always **try a mental method first** - ask the question "Can I solve this in my head?" Look at the actual numbers and not assume a large number requires a written method.
- Ensure that **mathematical inaccuracies are not introduced** through recording multi-step calculations horizontally, with imbalance either side of the equals sign
e.g. $20 \times 3 = 60$ $60 + 15 = 75$
not $20 \times 3 = 60 + 15 = 75$
- Children should always **estimate first**
- Always **check the answer**, preferably using a different method e.g. the inverse operation
- Children who make **persistent mistakes** should return to the method that they can use accurately until ready to move on
- Children need to **know number bonds and multiplication facts by heart** for more formal methods to be efficient
- When revising or extending to harder numbers, **refer back to expanded methods**. This helps reinforce understanding and reminds children that they have an alternative to fall back on if they are having difficulties.
- Use **appropriate models and images and practical equipment** when introducing or reviewing a concept
- A **range of vocabulary** should be used for each operation and attention paid to **mathematical language** modelled to children - be specific (e.g. quotient, product) and avoid misuse of vocabulary (e.g. sum)
- Children should be given the opportunity to **experience calculation in context**, through money and measure in real life contexts and problem solving situations
- Children should be given regular practise in **selecting their method and justifying** why this is the most appropriate method.

EYFS

Throughout EYFS mathematics development involves providing children with opportunities to practise and improve their skills in counting numbers, calculating simple addition and subtraction problems. In achieving the Early Learning Goal children will be able to count reliably with numbers from 1 to 20, place them in order and say which number is one more or one less than a given number. In addition, children will use quantities and objects to add and subtract two single-digit numbers and count on or back to find the answer. They will also solve problems, including doubling, halving and sharing.

KEY STAGE 1

Children in Years 1 and 2 will be given a really solid foundation in the basic building blocks of mental and written arithmetic. Through being taught place value, they will develop an understanding of how numbers work, so that they are confident in 2-digit numbers and beginning to read and say numbers above 100. A focus on number bonds, first via practical hands-on experiences and subsequently using memorisation techniques, enables a good grounding in these crucial facts, and ensures that all children leave Y2 knowing the pairs of numbers which make all the numbers up to 10 at least. They will also have experienced and been taught pairs to 20. Their knowledge of number facts enables them to add several single-digit numbers, and to add/subtract a single digit number to/from a 2-digit number. Another important conceptual tool is their ability to add/subtract 1 or 10, and to understand which digit changes and why. This understanding is extended to enable children to add and subtract multiples of ten to and from any 2-digit number. The most important application of this knowledge is their ability to add or subtract any pair of 2-digit numbers by counting on or back in tens and ones. Children may extend this to adding by partitioning numbers into tens and ones. Children will be taught to count in 2s, 3s, 5s and 10s, and will have related this skill to repeated addition. They will have met and begun to learn the associated 2x, 3x, 5x and 10x tables. Engaging in a practical way with the concept of repeated addition and the use of arrays enables children to develop a preliminary understanding of multiplication, and asking them to consider how many groups of a given number make a total will introduce them to the idea of division. They will also be taught to double and halve numbers, and will thus experience scaling up or down as a further aspect of multiplication and division. Fractions will be introduced as numbers and as operators, specifically in relation to halves, quarters and thirds.

LOWER KEY STAGE 2

In the lower juniors, children build on the concrete and conceptual understandings they have gained in the Infants to develop a real mathematical understanding of the four operations, in particular developing arithmetical competence in relation to larger numbers. In addition and subtraction, they are taught to use place value and number facts to add and subtract numbers mentally and will develop a range of strategies to enable them to discard the 'counting in ones' or fingers-based methods of the infants. In particular, they will learn to add and subtract multiples and near multiples of 10, 100 and 1000, and will become fluent in complementary addition as an accurate means of achieving fast and accurate answers to 3-digit subtractions. Standard written methods for adding larger numbers are taught, learned and consolidated, and written column subtraction is also introduced. This key stage is also the period during which all the multiplication and division facts are thoroughly memorised, including all facts up to the 12 x 12 table. Efficient written methods for multiplying or dividing a 2-digit or 3-digit number by a single-digit number are taught, as are mental strategies for multiplication or division with large but friendly numbers, e.g. when dividing by 5 or multiplying by 20. Children will develop their understanding of fractions, learning to reduce a fraction to its simplest form as well as finding non-unit fractions of amounts and quantities. The concept of a decimal number is introduced and children consolidate a firm understanding of one-place decimals, multiplying and dividing whole numbers by 10 and 100.

UPPER KEY STAGE 2

Children move on from dealing mainly with whole numbers to performing arithmetic operations with both decimals and fractions. They will consolidate their use of written procedures in adding and subtracting whole numbers with up to 6 digits and also decimal numbers with up to two decimal places. Mental strategies for adding and subtracting increasingly large numbers will also be taught. These will draw upon children's robust understanding of place value and knowledge of number facts. Efficient and flexible strategies for mental multiplication and division are taught and practised, so that children can perform appropriate calculations even when the numbers are large, such as $40,000 \times 6$ or $40,000 \div 8$. In addition, it is in Y5 and Y6 that children extend their knowledge and confidence in using written algorithms for multiplication and division. Fractions and decimals are also added, subtracted, divided and multiplied, within the bounds of children's understanding of these more complicated numbers, and they will also calculate simple percentages and ratios. Negative numbers will be added and subtracted.

PROGRESSION THROUGH CALCULATIONS FOR ADDITION

MENTAL CALCULATION FOR ADDITION

Mental recall of number bonds

- Addition pairs to 9+9
 $5 + 7 = 12$
- Addition complements to 10 and then 100
 $6 + 4 = 10$ $\square + 3 = 10$ $25 + 75 = 100$

Add a series of single digit numbers

$$4 + 8 + 5$$

Reorder sets of single digit numbers, looking for complements

$$3 + 6 + 7 + 4 = 3+7 + 6+4 = 10+10 = 20$$

Use near doubles

$$5 + 6 = \text{double } 5 + 1 = 11$$

Use related facts to add multiples of 10 and 100

$$6 + 7 = 13 \text{ so } 60 + 70 = 130 \text{ and } 600 + 700 = 1300$$

Addition using partitioning and recombining

$$\text{e.g. } 34 + 45 = (30 + 40) + (4 + 5) = 79$$

- using place value
 $145 = 100 + 40 + 5$
- in different ways
 $145 = 120 + 25$

Counting on or back in repeated steps of 1, 10, 100, 1000

$$86 + 57 = 143 \text{ (by counting on in tens and then in ones)}$$

$$460 - 300 = 160 \text{ (by counting back in hundreds)}$$

Add near multiples of 10 by adding the nearest multiple of 10, 100 and 1000 and adjusting

$$24 + 19 = 24 + 20 - 1 = 43$$

$$458 + 71 = 458 + 70 + 1 = 529$$

Use the relationship between addition and subtraction

$$36 + 19 = 55$$

$$19 + 36 = 55$$

$$55 - 19 = 36$$

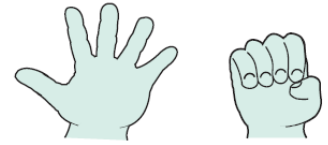
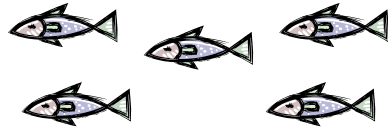
$$55 - 36 = 19$$

MOVING TOWARDS EFFICIENT WRITTEN METHODS FOR ADDITION

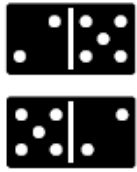
1) EARLY ADDITION: INFORMAL METHODS

Counting songs/rhymes

Pictorial and practical addition



5 in the bag and 3 more



$$15 + 5 = 20$$

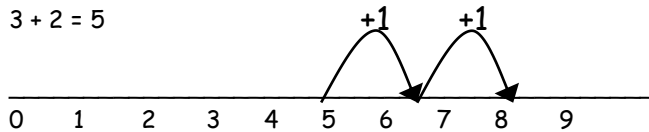
2) NUMBER LINES

Number lines and practical resources (e.g. bead strings) support calculation and teachers should *demonstrate* their use.

Number lines should be annotated and may be accompanied by informal jottings

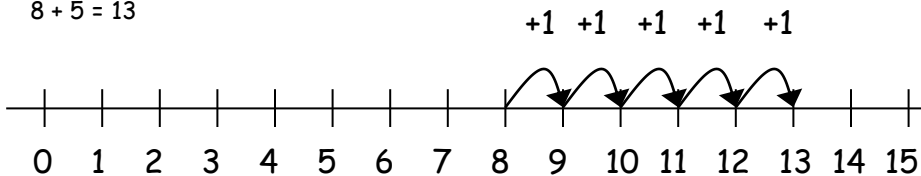
Count on from the largest number irrespective of the order of the calculation.

$$3 + 2 = 5$$



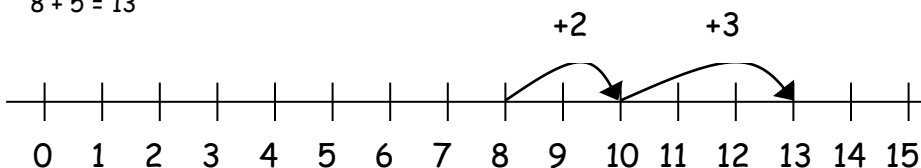
Counting on first in ones

$$8 + 5 = 13$$



Bridging through 10

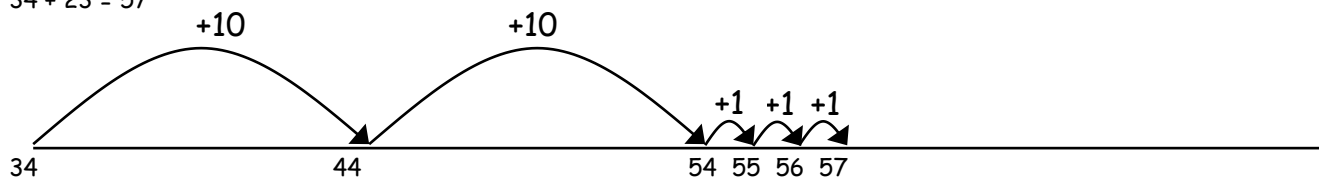
$$8 + 5 = 13$$



The number line can be used for progressing to larger numbers, in preparation for partitioning.

Counting on in tens and ones

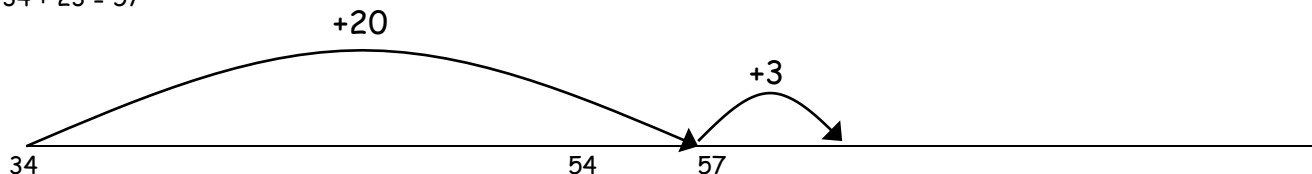
$$34 + 23 = 57$$



Counting on in multiples of tens and ones

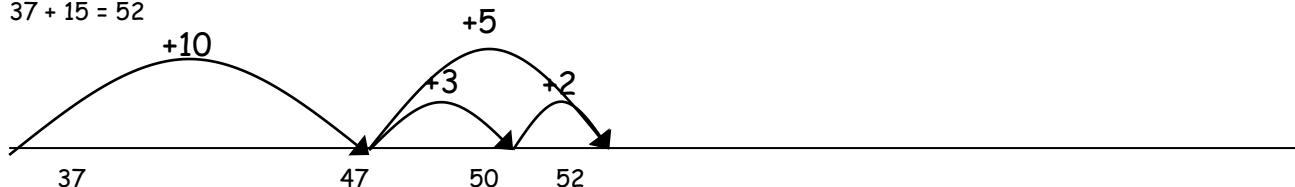
Using fewer steps by adding the ones and eventually tens in one jump (by using the known facts $4 + 3 = 7$ and $30 + 20 = 50$).

$$34 + 23 = 57$$



Bridging through multiples of ten

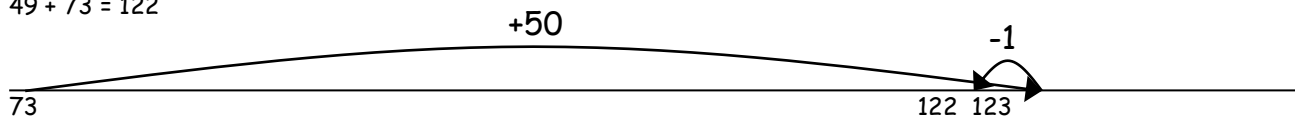
$$37 + 15 = 52$$



3) COMPENSATION

Adding a near multiple of 10 or 100 and adjusting

$$49 + 73 = 122$$



4) EXPANDED METHODS: PARTITIONING

This should be encouraged alongside number lines as early as possible.

Initially, record steps in the number line method using informal jottings

$$58 + 87$$

$$50 + 80 = 130$$

$$8 + 7 = 15$$

$$130 + 15 = 145$$

Leading to partitioned numbers being written under one another: -

$$\begin{array}{r} 50 \quad 8 \\ \underline{80 \quad 7} \\ 130 \quad 15 = 145 \end{array}$$

Expanded Methods leading to "Column Addition"

Option 1 - Adding most significant digits first, then moving to adding least significant digits.

$$\begin{array}{r} 67 \\ + 24 \\ \hline 80 \quad (60 + 20) \\ \underline{11} \quad (7 + 4) \\ 91 \end{array}$$

$$\begin{array}{r} 267 \\ + 85 \\ \hline 200 \\ 140 \quad (60 + 80) \\ \underline{12} \quad (7 + 5) \\ 352 \end{array}$$

Option 2 - Moving to adding the least significant digits first in preparation for 'carrying'.

$$\begin{array}{r} 67 \quad 267 \\ + 24 \\ \hline 11 \quad (7 + 4) \\ \underline{80} \quad (60 + 20) \\ 91 \end{array}$$

$$\begin{array}{r} + 85 \\ \hline 12 \quad (7 + 5) \\ 140 \quad (60 + 80) \\ \underline{200} \quad (200 + 0) \\ 352 \end{array}$$

5) EFFICIENT WRITTEN METHOD - "COLUMN ADDITION"

From this, children will begin to carry below the line.

$$\begin{array}{r} 625 \\ + 48 \\ \hline 673 \\ 1 \end{array}$$

$$\begin{array}{r} 783 \\ + 42 \\ \hline 825 \\ 1 \end{array}$$

$$\begin{array}{r} 367 \\ + 85 \\ \hline 452 \\ 11 \end{array}$$

Using similar methods, children will:

- add several numbers with different numbers of digits so that more than one ten or hundred is carried;
- add decimal numbers, including amounts of money and measures, knowing that the decimal points should line up under each other, particularly when adding or subtracting mixed amounts, e.g. £3.59 + 78p and where numbers have different numbers of decimal places

$$\begin{array}{r} 65.8 \\ + 58.48 \\ \hline 124.28 \\ 11 \end{array}$$

$$\begin{array}{r} 42 \\ 6432 \\ 786 \\ 3 \\ + 4681 \\ \hline 11944 \\ 121 \end{array}$$

PROGRESSION THROUGH CALCULATIONS FOR SUBTRACTION

MENTAL CALCULATION FOR SUBTRACTION

Mental recall of addition and subtraction facts

- Addition and subtraction complements to 10 and 20
- Addition and subtraction facts to 20
- Addition and subtraction complements of multiples of 10 to 100

$$\begin{array}{lll} 10 - 6 = 4 & 17 - \square = 11 & 100 - 30 = 70 \\ 20 - 17 = 3 & 10 - \square = 2 & 100 - \square = 60 \end{array}$$

Use related facts

If $14 - 8 = 6$ then $140 - 80 = 60$ and $1400 - 800 = 600$

Find a small difference by counting up

$$82 - 79 = 3$$

Counting on or back in repeated steps of 1, 10, 100, 1000

$86 - 52 = 34$ (by counting back in tens and then in ones)

$460 - 300 = 160$ (by counting back in hundreds)

Compensation - Subtract the nearest multiple of 10, 100 and 1000 and adjust

$$24 - 19 = 24 - 20 + 1 = 5$$

$$458 - 71 = 458 - 70 - 1 = 387$$

Use the relationship between addition and subtraction

$$36 + 19 = 55 \qquad 19 + 36 = 55$$

$$55 - 19 = 36 \qquad 55 - 36 = 19$$

Partition numbers:

- using place value
 $74 = 70 + 4$
- in different ways in preparation for decomposition
 $74 = 60 + 14$

COUNTING ON OR COUNTING BACK?

When subtracting, whether mental or written, children will mainly choose between two main strategies: -

- Taking away (Counting Back)
- Complementary Addition (Counting On)

The decision to count on or back will depend on the calculation but often the following rules apply:

- If the numbers are far apart, or there isn't much to subtract ($278 - 24$) then count back.
- If the numbers are close together ($206 - 188$), then count up
- In many cases, either strategy would be suitable

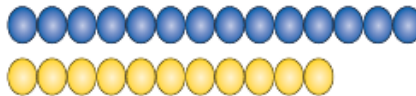
MOVING TOWARDS EFFICIENT WRITTEN METHODS FOR SUBTRACTION

1) EARLY SUBTRACTION: INFORMAL METHODS

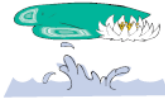
Counting songs/rhymes

Pictorial and practical Subtraction

$$9 - 5 = 4$$



The difference is?



$$5 - \square = 3$$

$$\square - 2 = 3$$

2) NUMBER LINES

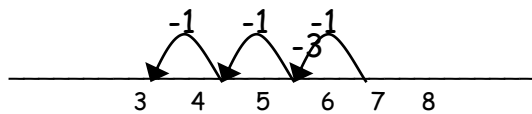
Children use number lines and practical resources (e.g. bead strings) to support calculation.

Teachers *demonstrate* the use of the numberline.

COUNTING BACK

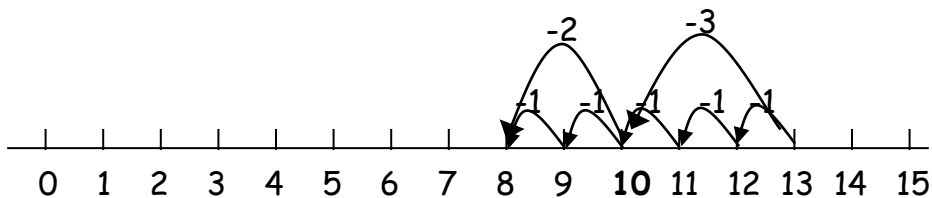
$$6 - 3 = 3$$

-3



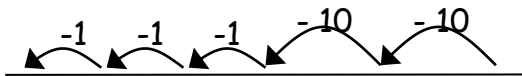
Children then begin to use numbered lines to support their own calculations - using a numbered line to count back in ones, leading to bridging through a multiple of 10.

$$13 - 5 = 8$$



Larger numbers will be introduced with children counting back in tens and ones, leading to fewer steps

$$47 - 23 = 24$$

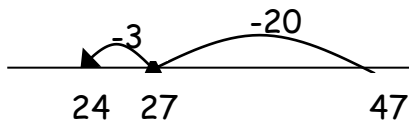


$$47 - 23 = 24$$



Subtracting the tens in one jump and the ones in one jump.

$$47 - 23 = 24$$



Children begin to record informal jottings:

This should be encouraged alongside number lines.

$$47 - 20 = 27$$

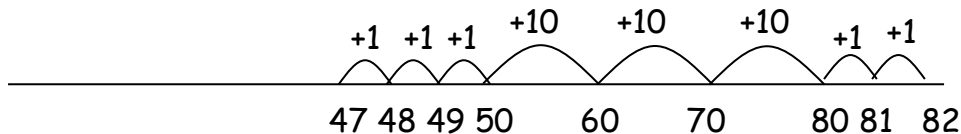
$$27 - 3 = 24$$

Or $47 - 20 - 3 = 24$

COUNTING ON

If the numbers involved in the calculation are close together or near to multiples of 10, 100 etc, it can be more efficient to count on. Children need experience of making this decision.

$$82 - 47$$



3) PARTITIONING (LEADING TO DECOMPOSITION)

This process should be demonstrated using arrow cards to show the partitioning and base 10 materials or straw bundles to show the decomposition of the number.

NOTE When solving the calculation $89 - 57$, children should know that 57 **does NOT EXIST AS AN AMOUNT** it is what you are subtracting from the other number. Therefore, when using base 10 materials, children would need to count out only the 89.

$$\begin{array}{r} 89 \\ - 57 \\ \hline \end{array} = \begin{array}{r} 80 \quad 9 \\ 50 \quad 7 \\ \hline 30 \quad 2 = 32 \end{array}$$

From this the children will begin to EXCHANGE, NOT BORROW.

$$\begin{array}{r} 71 \\ - 46 \\ \hline \end{array}$$

Step 1 $\begin{array}{r} 70 \quad 1 \\ - 40 \quad 6 \\ \hline \end{array}$

Step 2 $\begin{array}{r} 60 \quad 11 \\ - 40 \quad 6 \\ \hline 20 \quad 5 = 25 \end{array}$

This would be recorded by the children as

$$\begin{array}{r} \overset{60}{\cancel{70}} \quad \overset{1}{1} \\ - \quad \underline{40 \quad 6} \\ 20 \quad 5 = 25 \end{array}$$

PROGRESSING TO 3 DIGIT NUMBERS

$$\begin{array}{r} 754 \\ - 86 \\ \hline \end{array}$$

Step 1

$$\begin{array}{r} 700 \quad 50 \quad 4 \\ - \quad \underline{80 \quad 6} \end{array}$$

Step 2

$$\begin{array}{r} 700 \quad 40 \quad 14 \quad (\text{adjust from } T \text{ to } O) \\ - \quad \underline{80 \quad 6} \end{array}$$

Step 3

$$\begin{array}{r} 600 \quad 140 \quad 14 \quad (\text{adjust from } H \text{ to } T) \\ - \quad \underline{80 \quad 6} \\ 600 \quad 60 \quad 8 = 668 \end{array}$$

This would be recorded by the children as

$$\begin{array}{r} \overset{600}{\cancel{700}} \quad \overset{140}{\cancel{50}} \quad \overset{1}{14} \\ - \quad \underline{80 \quad 6} \\ 600 \quad 60 \quad 8 = 668 \end{array}$$

AND DECIMALS

$$\begin{array}{r} \pounds 8.95 \\ - \underline{\pounds 4.38} \end{array} = \begin{array}{r} 8 \quad 0.9 \quad 0.05 \\ - 4 \quad 0.3 \quad 0.08 \end{array}$$

leading to

$$\begin{array}{r} = \begin{array}{r} 8 \quad 0.8 \quad 0.15 \\ - 4 \quad 0.3 \quad 0.08 \\ \hline 4 \quad 0.5 \quad 0.07 \end{array} \quad (\text{adjust from } T \text{ to } O) \\ = \pounds 4.57 \end{array}$$

$$\begin{array}{r} 8.95 \\ - \underline{4.38} \\ 4.57 \end{array}$$

Alternatively, children can set the amounts to whole numbers, i.e. 895 - 438 and convert to pounds after the calculation.

4) DECOMPOSITION - COLUMN SUBTRACTION

Numbers should continue to be referred to by their values and not their digits.

e.g. 140 - 80 or 14 tens - 8 ones as opposed to 14 - 8

$$\begin{array}{r} 7 \quad 14 \quad 1 \\ \cancel{8} \quad \cancel{5} \quad \cancel{4} \\ - \underline{2 \quad 8 \quad 6} \\ 5 \quad 6 \quad 8 \end{array} \quad \begin{array}{r} 1 \quad 1316 \quad 111 \\ 3 \quad 4 \quad \cancel{7} \quad \cancel{2} \quad \cancel{6} \\ - \underline{1 \quad 8 \quad 9 \quad 5 \quad 8} \\ 1 \quad 5 \quad 7 \quad 6 \quad 8 \end{array}$$

This should be extended to exchange across two places due to the presence of a zero.

$$\begin{array}{r} 9 \\ 5 \quad \cancel{1} \quad 1 \\ \cancel{6} \quad 0 \quad 5 \\ - \underline{3 \quad 2 \quad 8} \\ 2 \quad 7 \quad 7 \end{array}$$

PROGRESSION THROUGH CALCULATIONS FOR MULTIPLICATION

MENTAL CALCULATION FOR MULTIPLICATION

Doubling and halving

Applying the knowledge of doubles and halves to known facts.

e.g. 8×4 is double 4×4

Using multiplication facts

Know multiplication facts to 12×12

Recognise relationships between multiples e.g. $5/10$, $3/6/9$, $2/4/8$, etc

Using and applying multiplication facts

Children should be able to utilise their tables knowledge to derive other facts.

e.g. If I know $3 \times 7 = 21$, what else do I know?

$30 \times 7 = 210$, $300 \times 7 = 2100$, $3000 \times 7 = 21\,000$, $0.3 \times 7 = 2.1$ etc

Use closely related facts already known

$$\begin{aligned} 13 \times 11 &= (13 \times 10) + (13 \times 1) \\ &= 130 + 13 \\ &= 143 \end{aligned}$$

Multiplying by 10 or 100

Knowing that the effect of multiplying by 10 is a shift in the digits one place to the left.

Knowing that the effect of multiplying by 100 is a shift in the digits two places to the left.

Partitioning

Using place value

$$\begin{aligned} \text{e.g. } 23 \times 4 &= (20 \times 4) + (3 \times 4) \\ &= 80 + 12 \\ &= 92 \end{aligned}$$

In different ways

$$\begin{aligned} \text{e.g. } 145 &= 120 + 25 \\ \text{So } 145 \times 6 &= (120 \times 6) + (25 \times 6) \\ &= 720 + 150 \end{aligned}$$

Factorising - Use of factors

$$8 \times 12 = 8 \times (4 \times 3)$$

$$18 \times 4 = 18 \times (2 \times 2)$$

Inverses

Using symbols to stand for unknown numbers to complete equations using inverse operations

$$\square \times 5 = 20 \qquad 3 \times \triangle = 18 \qquad \square \times \circ = 32$$

This leads into algebraic notation e.g. $5n = 15$

NOTE:

Children must be taught to recognise when there is a quicker mental method, even for larger numbers.

e.g. For a calculation such as 25×24 , a quicker method would be

'there are four 25s in 100 so $25 \times 24 = 100 \times 6 = 600$

TERMINOLOGY

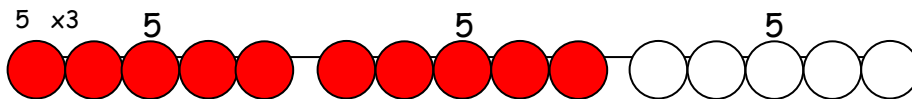
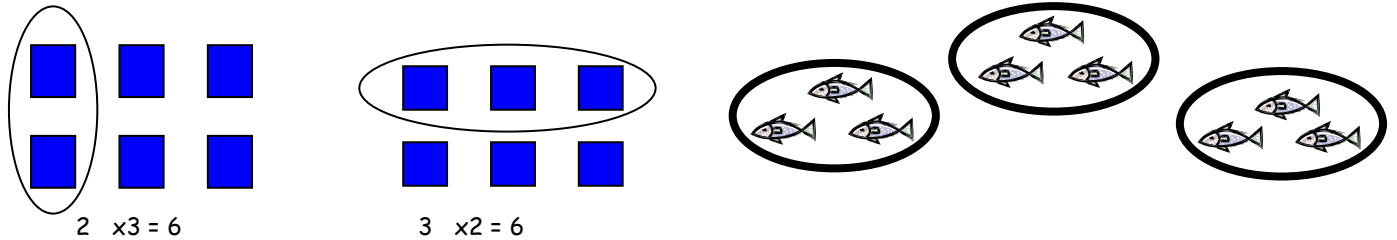
Short multiplication - multiplication by a single digit, using any method

Long multiplication - multiplication by two or more digits, using any method

MOVING TOWARDS EFFICIENT WRITTEN METHODS FOR MULTIPLICATION

1) MODELS AND IMAGES

Children will experience equal groups of objects and will count in 2s and 10s and begin to count in 5s. They will work on practical problem solving activities involving equal sets or groups. They will visualise sets of objects in arrays.



SCALING

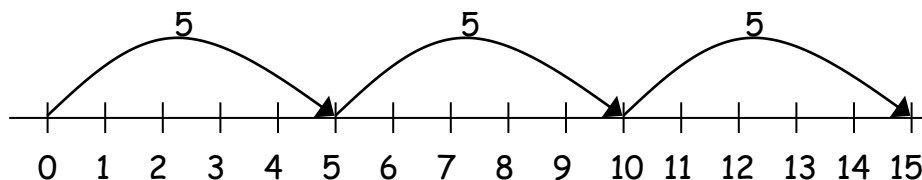
e.g. Find a ribbon that is 4 times as long as the blue ribbon



2) NUMBER LINES: REPEATED ADDITION

3 times 5 is $5 + 5 + 5 = 15$
 or 3 lots of 5
 or 5×3 (record as 5×3 so the association is "3 lots of 5")

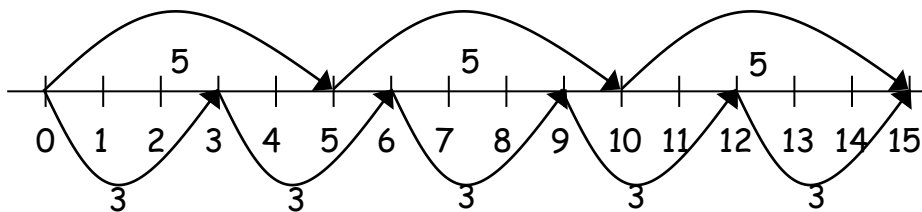
$$5 \times 3 = 5 + 5 + 5$$



and on a bead bar:

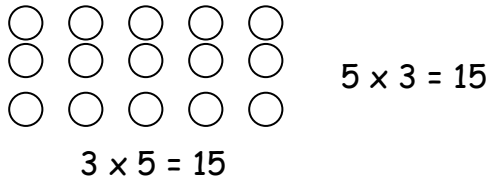
COMMUTATIVITY

Children should know that 3×5 has the same answer as 5×3 . This can also be shown on the number line.



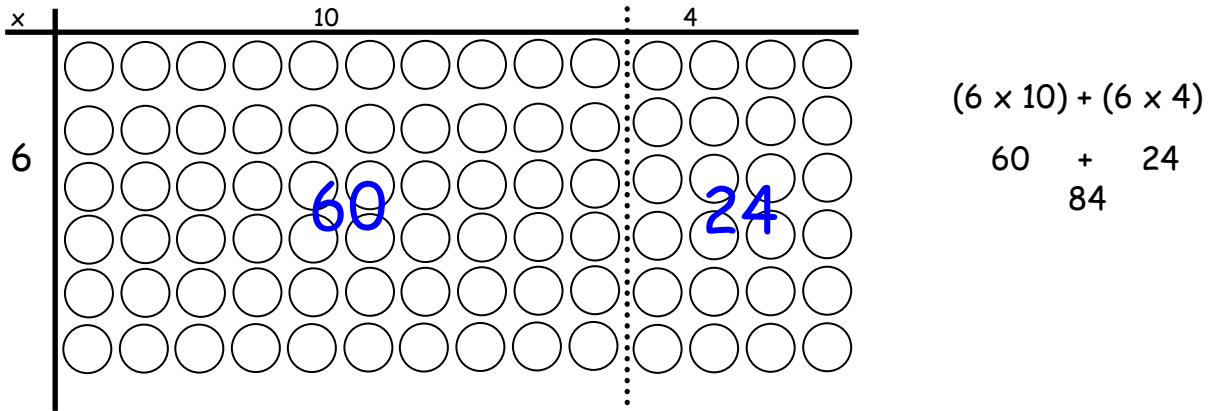
3) ARRAYS

Children should be able to model a multiplication calculation using an array.
This knowledge will support with the development of the grid method.



4) GRID METHOD

Children will continue to use arrays where appropriate leading into the grid method of multiplication.



TO x O

x	30	8	
38 x 7	210	56	266

TO x TO

x	20	7	
50	1000	350	1120
6	120	42	392
			1512

Decimals

e.g. 4.92×3

x	4	0.9	0.02	
3	12	2.7	0.06	14.76

5) PARTITIONING

$$\begin{aligned} 38 \times 5 &= (30 \times 5) + (8 \times 5) \\ &= 150 + 40 \\ &= 190 \end{aligned}$$

OR $30 \times 5 = 150$ $8 \times 5 = 40$ $150 + 40 = 190$ recorded horizontally or vertically

6) VERTICAL FORMAT: EXPANDED WORKING, LEADING TO EFFICIENT COMPACT METHOD

SHORT MULTIPLICATION

$$\begin{array}{r} 38 \\ \times \quad 7 \\ \hline 56 \quad (8 \times 7) \\ \underline{210} \quad (30 \times 7) \\ \hline 266 \end{array}$$

$$\begin{array}{r} 378 \\ \times \quad 4 \\ \hline 32 \\ 280 \\ \hline 1200 \\ \underline{1512} \end{array} \quad \longrightarrow \quad \begin{array}{r} 378 \\ \times \quad 4 \\ \hline 1512 \\ 33 \end{array}$$

LONG MULTIPLICATION

$$\begin{array}{r} 38 \\ \times 57 \\ \hline 266 \\ \underline{1900} \\ \hline 2166 \end{array}$$

$$\begin{array}{r} 423 \\ \times 68 \\ \hline 3384 \\ \underline{25380} \\ \hline 28764 \\ 1 \end{array}$$

PROGRESSION THROUGH CALCULATIONS FOR DIVISION

MENTAL CALCULATION FOR DIVISION

Doubling and halving

Knowing that halving is dividing by 2

Deriving and recalling division facts

Know multiplication and corresponding division facts to 12×12

e.g. $24 \div 4 = 6$ because $6 \times 4 = 24$

Using and applying division facts

Children should be able to utilise their tables knowledge to derive other facts.

e.g. If I know $3 \times 7 = 21$, then I know $21 \div 7 = 3$ $210 \div 7 = 30$ etc

Dividing by 10 or 100

Knowing that the effect of dividing by 10 is a shift in the digits one place to the right.

Knowing that the effect of dividing by 100 is a shift in the digits two places to the right.

Partition in different ways

Using place value e.g. $63 \div 3$ = $(60 \div 3) + (3 \div 3)$ = $20 + 1 = 21$

In different ways e.g. $81 \div 3$ = $(60 \div 3) + (21 \div 3)$ = $20 + 7 = 27$

Factorising: Use of factors

$378 \div 21$ $378 \div 3 = 126$ $378 \div 21 = 18$

$126 \div 7 = 18$

Using symbols

Symbols represent unknown numbers to complete equations using inverse operations, leading to algebraic notation

$$\square \div 2 = 4$$

$$20 \div \triangle = 4$$

$$\square \div \triangle = 4$$

KEY VOCABULARY:

$$18 \div 3 = 6$$

- Dividend - the number to be divided (18)
- Divisor - the number being used to divide (3)
- Quotient - the answer after division (6)

REMAINDERS

Any remainders should be shown:

- first as integers, i.e. 14 remainder 2 or $14 \text{ r } 2$.
- as fractions, i.e. if the children were dividing 32 by 10, the answer should be shown as $3 \frac{2}{10}$ which could then be written as $3 \frac{1}{5}$ in it's lowest terms.
- as decimals, by extending the dividend with a decimal point and several decimal place holders

3 $\overline{)1.000000}$

ROUNDING UP OR DOWN AFTER DIVISION

Children need to be able to decide what to do after division and round up or down accordingly.

e.g. $62 \div 8$ is 7 remainder 6, but whether the answer should be rounded up to 8 or rounded down to 7 depends on the context.

- I have 62p. Sweets are 8p each. How many can I buy?
Answer: 7 (the remaining 6p is not enough to buy another sweet)
- Apples are packed into boxes of 8. There are 62 apples. How many boxes are needed?
Answer: 8 (the remaining 6 apples still need to be placed into a box)

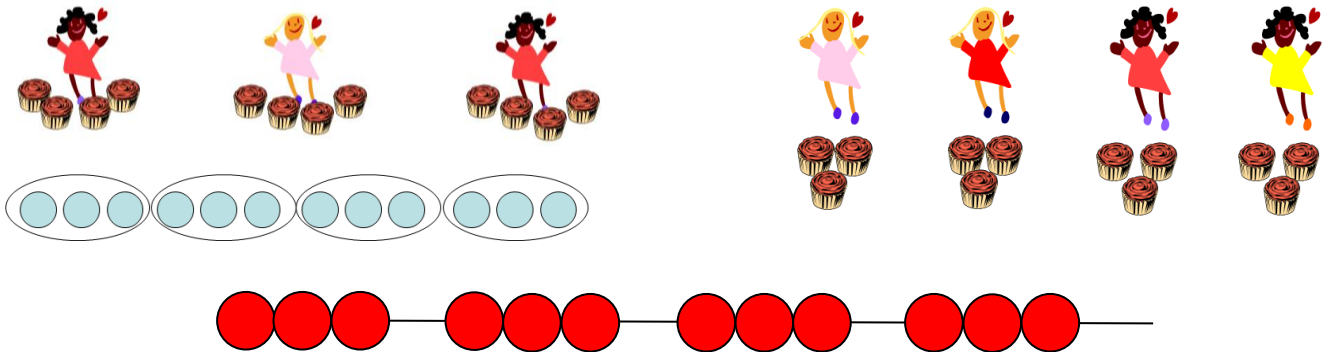
MOVING TOWARDS EFFICIENT WRITTEN METHODS FOR DIVISION

1) INFORMAL METHODS - PICTORIAL REPRESENTATIONS

Children will understand equal groups and share items out in play and problem solving.

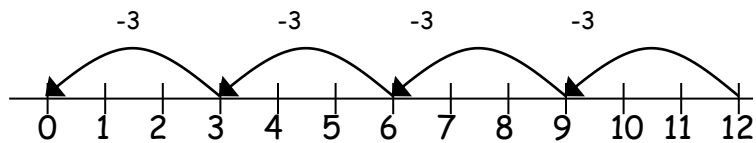
They will count in 2s and 10s and later in 5s.

Children will develop their understanding of division and use jottings to support calculation



2) NUMBER LINES - REPEATED SUBTRACTION

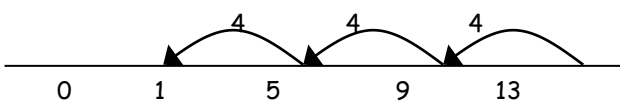
$$12 \div 3 = 4$$



REMAINDERS

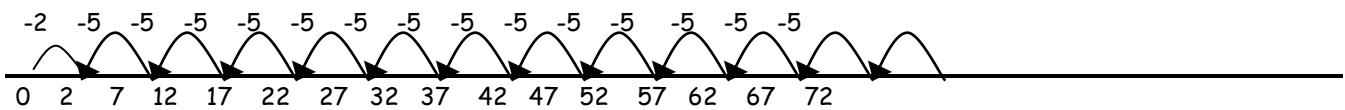
Children should also move onto calculations involving remainders, recording as whole numbers

$$13 \div 4 = 3 \text{ r } 1$$

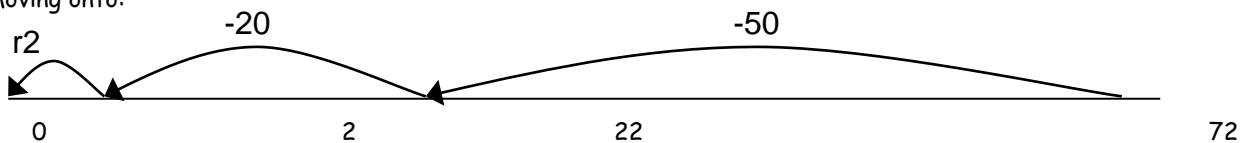


LARGER NUMBERS, USING MULTIPLES OF THE DIVISOR

$$72 \div 5$$

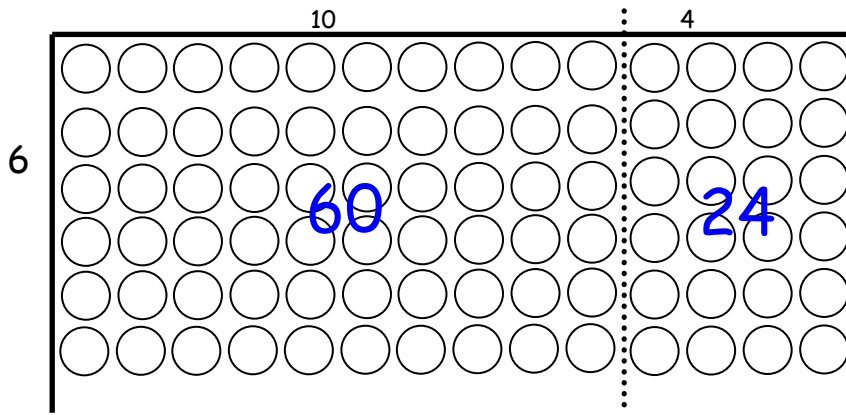


Moving onto:



3) PARTITIONING NUMBERS IN DIFFERENT WAYS

USING ARRAYS TO VISUALISE



$$84 = 60 + 24$$

so

$$\begin{aligned} 84 \div 6 &= (60 \div 6) + (24 \div 6) \\ &= 10 + 4 \\ &= 14 \end{aligned}$$

This leads into the more compact method and demonstrates the exchange process visually.

4) COMPACT WRITTEN METHOD: BUS SHELTER

First, the expanded form should be used, enabling children to "see" the carried digits.

$$222 \div 6 = 37$$

Partition into

$$\begin{array}{r} 30 + 7 \\ 6 \overline{)180 + 42} \end{array} \quad \begin{array}{r} 37 \\ 6 \overline{)222} \end{array}$$

$$583 \div 4 = 145 \text{ r } 3$$

$$\begin{array}{r} 100 + 40 + 5 \quad \text{R } 3 \\ 4 \overline{)400 + 160 + 23} \end{array}$$

Long division uses the same method.

Due to the size of the divisor, children should be encouraged to make a list of multiples before beginning. They may carry 2 digits in some cases.

To avoid this in the limited working space alongside difficult mental subtractions to find the remainder, this part could be shown below the dividend.

$$\begin{array}{r} 2191 \\ 4 \overline{)8764} \\ \underline{8} \\ 07 \\ \underline{04} \\ 36 \\ \underline{36} \\ 04 \\ \underline{04} \\ 0 \end{array}$$

$$\begin{array}{r} 21 \\ 216 \overline{)4536} \\ \underline{432} \\ 216 \\ \underline{216} \\ 0 \end{array}$$

$$\begin{array}{r} 17 \text{ r } 19 \\ 31 \overline{)546} \\ \underline{31} \\ 236 \\ \underline{217} \\ 19 \end{array}$$

how many per store? \rightarrow $3,524 \text{ R } 6$

$$\begin{array}{r} 24 \\ 48 \\ 72 \\ 96 \\ 120 \\ 144 \\ 168 \\ 192 \\ 216 \\ 240 \end{array} \quad \begin{array}{r} 24 \overline{)85,582} \\ \underline{72} \\ 125 \\ \underline{120} \\ 58 \\ \underline{48} \\ 102 \\ \underline{96} \\ 6 \end{array}$$

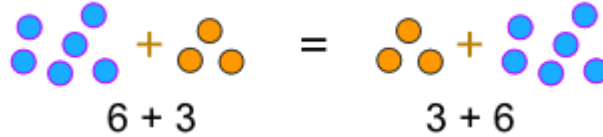
APPENDIX: COMMUTATIVE, ASSOCIATIVE AND DISTRIBUTIVE LAWS

COMMUTATIVE LAWS

The "Commutative Laws" say you can **swap numbers** over and still get the same answer ...

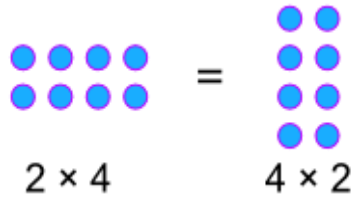
... when you **add**: $a + b = b + a$

Example:



... or when you **multiply**: $a \times b = b \times a$

Example:



NOTE: The Commutative Law does **not** work for division or subtraction:

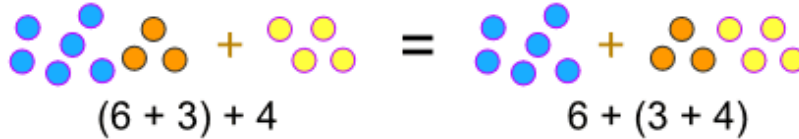
Example:

- $12 / 3 = 4$ but $3 / 12 = \frac{1}{4}$
- $15 - 4 = 11$ but $4 - 15 = -11$

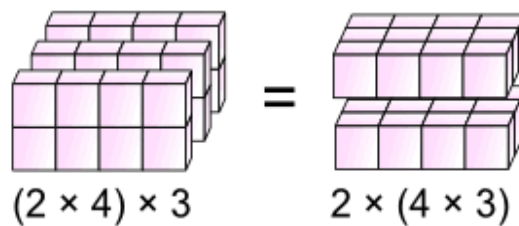
ASSOCIATIVE LAWS

The "Associative Laws" say that it doesn't matter which numbers you calculate first...

... when you **add**: $(a + b) + c = a + (b + c)$



... or when you **multiply**: $(a \times b) \times c = a \times (b \times c)$



Examples:

This: $(2 + 4) + 5 = 6 + 5 = 11$
has the same answer as this: $2 + (4 + 5) = 2 + 9 = 11$

This: $(3 \times 4) \times 5 = 12 \times 5 = 60$
has the same answer as this: $3 \times (4 \times 5) = 3 \times 20 = 60$

USES:

Sometimes it is easier to add or multiply in a different order:

Example:

$$19 + 36 + 4 = 19 + (36 + 4) = 19 + 40 = 59$$

Or to rearrange a little:

Example:

$$2 \times 16 \times 5 = (2 \times 5) \times 16 = 10 \times 16 = 160$$

NOTE: The Associative Law does **not** work for subtraction:

Example:

- $(9 - 4) - 3 = 5 - 3 = 2$, but
- $9 - (4 - 3) = 9 - 1 = 8$

DISTRIBUTIVE LAW

The "distributive laws" say that you get the same answer when you:

- multiply a number by a **group of numbers added together**, or
- do each **multiply** separately then **add** them

$$3 \times (2+4) = 3 \times 2 + 3 \times 4$$

3 lots of $(2+4)$ is the same as 3 lots of 2 plus 3 lots of 4

So, the $3 \times$ can be "distributed" across the $2+4$, into 3×2 and 3×4

and we write it like this:

$$a \times (b + c) = a \times b + a \times c$$

USES:

Sometimes it is easier to break up a difficult multiplication:

Example:

$$6 \times 204 = 6 \times 200 + 6 \times 4 = 1,200 + 24 = 1,224$$

Or to combine:

What is $16 \times 6 + 16 \times 4$?

$$16 \times 6 + 16 \times 4 = 16 \times (6+4) = 16 \times 10 = 160$$

You can use it in subtraction too:

$$26 \times 3 - 24 \times 3$$

$$26 \times 3 - 24 \times 3 = (26 - 24) \times 3 = 2 \times 3 = 6$$

You could use it for a long list of additions, too:

$$6 \times 7 + 2 \times 7 + 3 \times 7 + 5 \times 7 + 4 \times 7 = (6+2+3+5+4) \times 7 = 20 \times 7 = 140$$

NOTE: The Distributive Law does **not** work for division:

Example:

- $24 / (4 + 8) = 24 / 12 = 2$, but
- $24 / 4 + 24 / 8 = 6 + 3 = 9$

SUMMARY

COMMUTATIVE LAWS:

$$a + b = b + a$$

$$a \times b = b \times a$$

ASSOCIATIVE LAWS:

$$(a + b) + c = a + (b + c)$$

$$(a \times b) \times c = a \times (b \times c)$$

DISTRIBUTIVE LAW:

$$a \times (b + c) = a \times b + a \times c$$