Mathematics progression skills with reasoning – Power Maths

Year 6

Number: Number and Place Value with Reasoning

COUNTING
Year 6
use negative numbers in context, and calculate intervals across zero Autumn: Unit: 1
Spot the mistake: -80,-40,10,50 What is wrong with this sequence of numbers? **True or False?** When I count backwards in 50s from 10 I will say -200 **True or False?** The temperature is -3. It gets 2 degrees warmer. The new temperature is -5?
COMPARING NUMBERS
read, write, order and compare numbers up to 10 000 000 and determine the value of each digit (appears also in Reading and Writing Numbers) Autumn: Unit: 1
Do, then explain Find out the populations in five countries. Order the populations starting with the largest. Explain how you ordered the countries and their populations.

IDENTIFYING, REPRESENTING AND ESTIMATING NUMBERS

Children should be secure in these. Continue to consolidate.

READING AND WRITING NUMBERS (including Roman Numerals

read, write, order and compare numbers up to
10 000 000 and determine the value of each digit
(appears also in Understanding Place Value)

Autumn: Unit 1

UNDERSTANDING PLACE VALUE

read, write, order and compare numbers up to
10 000 000 and determine the value of each digit (appears also in Reading and Writing Numbers)

Autumn: Unit 1

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 (copied from Fractions)

Spring: Unit 7

Do, then explain
Show the value of the digit 6 in these numbers?
6787555 95467754
Expalin how you know.

Make up an example Create seven digit numbers where the digit sum is six and the tens of thousands digit is two.
Eg 4020000
What is the largest/smallest number?

ROUNDING

round any whole number to a required degree of accuracy

Autumn: Unit 1

solve problems which require answers to be rounded to specified degrees of accuracy (copied from Fractions)

Spring: Units 7 and 8

Possible answers
Two numbers each with two decimal places round to 23.1 to one decimal place. The total of the numbers is 46.2. What could the numbers be?

What do you notice?
Give an example of a six digit number which rounds to the same number when rounded to the nearest 10000 and 100000

PROBLEM SOLVING

solve number and practical problems that involve all of the above

Autumn: Unit 1
Summer: Unit 14

Number: Addition and Subtraction with Reasoning

NUMBER BONDS

Year 6

KIRFs, Fluent in 5, Manipulating the additive relationship and securing mental calculation., Beat That

MENTAL CALCULATION

perform mental calculations, including with mixed operations and large numbers

Autumn: Unit 3

True or false?
Are these number sentences true or false?6.32 + ☐ = 8
☐ = 1.68

Give your reasons.

Hard and easy questions
Which questions are easy / hard?

213323 - 70 =
512893 + 37 =
8193.54 - 5.9 =
Explain why you think the hard questions are hard?

use their knowledge of the order of operations to carry out calculations involving the four operations

Autumn: Units 3 and 5

Summer: Unit 14

Missing symbols
Write the missing signs
(+ - x ÷) in this number sentence:

6 ◯ 12.3 = 61.9 ◯ 11.9

What else do you know?
If you know this:
86.7 + 13.3 = 100
what other facts do you know?

WRITTEN METHODS

read, write and interpret mathematical statements involving addition (+), subtraction (-) and equals (=) signs
(appears also in Mental Calculation)

Autumn: Units 2, 3 and 4

Spring: Unit 8

Convince me
Three four digit numbers total 12435.
What could they be?
Convince me

INVERSE OPERATIONS, ESTIMATING AND CHECKING ANSWERS

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

Summer: Units 14 and 15

Making an estimate
Circle the number that is the best estimate to
932.6 - 931.05

1.3 1.5 1.7 1.9

Always, sometimes, never

Is it always, sometimes or never true that the sum of two consecutive triangular numbers is a square number

PROBLEM SOLVING

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

Summer: Unit 14

Solve problems involving addition, subtraction, multiplication and division

Autumn: Unit 3

Summer: Unit 14

Number: Multiplication and Division with Reasoning

MULTIPLICATION & DIVISION FACTS

Year 6

Missing numbers

2.4 ÷ 0.3 = ☐ x 1.25

Which number could be written in the box?

Making links

MENTAL CALCULATION

perform mental calculations, including with mixed operations and large numbers

Autumn: Unit 3

Use a fact

12 x 1.1 = 13.2
Use this fact to work out
15.4 ÷ 1.1 =
27.5 ÷ 1.1 =

associate a fraction with division and calculate decimal fraction equivalents (e.g. 0.375) for a simple fraction (e.g. $^{3}/_{8}$)
(copied from Fractions)

Spring: Unit 7

Making links

0.7 x 8 = 5.6
How can you use this fact to solve these calculations?
0.7 x 0.08 =
0.56 ÷ 8 =

WRITTEN CALCULATION

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

Autumn: Unit 2

divide numbers up to 4-digits by a two-digit whole number using the formal written method of short division where appropriate for the context

Autumn: Unit 2

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

Autumn: Unit 2

use written division methods in cases where the answer has up to two decimal places (copied from Fractions (including decimals)

Autumn: Units 5 and 7

Prove It

What goes in the missing box?

18 □4 ÷ 12 = 157

38 □5 ÷ 18 = 212.5

33 □2 ÷ 8 = 421.5

38 x □.7 = 178.6

Prove it.

Can you find?

Can you find the smallest number that can be added to or subtracted from 87.6 to make it exactly divisible by 8/7/18?

PROPERTIES OF NUMBERS: MULTIPLES, FACTORS, PRIMES, SQUARE AND CUBE NUMBERS

identify common factors, common multiples and prime numbers

Autumn: Unit 5

use common factors to simplify fractions; use common multiples to express fractions in the same denomination
(copied from Fractions)

Autumn: Unit 4

calculate, estimate and compare volume of cubes and cuboids using standard units, including centimetre cubed (cm^3) and cubic metres (m^3), and extending to other units such as mm^3 and km^3
(copied from Measures)

Spring: Unit 11

Always, sometimes, never?

Is it always, sometimes or never true that dividing a whole number by a half makes the answer twice as big.

Is it always, sometimes or never true that when you square an even number, the result is divisible by 4

Is it always, sometimes or never true that multiples of 7 are 1 more or 1 less than prime numbers.

ORDER OF OPERATIONS

use their knowledge of the order of operations to carry out calculations involving the four operations

Autumn: Unit 3

Summer: Unit 14

Which is correct?
Which of these number sentences is correct?
3 + 6 x 2 =15
6 x 5 – 7 x 4 = 92
8 x 20 ÷ 4 x 3 = 37

INVERSE OPERATIONS, ESTIMATING AND CHECKING ANSWERS

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

Summer: Units14 and 15

Use the inverse
Use the inverse to check if the following calculations are correct:
2346 x 46 = 332796
27.74 ÷ 19 = 1.46

Size of an answer
The product of a single digit number and a number with two decimal places is 21.34
What could the numbers be?

PROBLEM SOLVING

solve problems involving addition, subtraction, multiplication and division Summer: Unit 14	*solve problems involving similar shapes where the scale factor is known or can be found* (copied from Ratio and Proportion) Spring: Unit 12

Number: Fractions (including Decimals and Percentages) Reasoning

Year 6

COUNTING IN FRACTIONAL STEPS

Spot the mistake

Identify and explain mistakes when counting in more complex fractional steps

RECOGNISING FRACTIONS

What do you notice?

One thousandth of my money is 31p. How much do I have?

True or false?
25% of 23km is longer than 0.2 of 20km.
Convince me.

COMPARING FRACTIONS

compare and order fractions, including fractions >1

Autumn: Unit 4
Spring: Unit 8

Give an example of a **fraction** that is greater than 1.1 and less than 1.5.
Now another example that no one will think of. Explain how you know.

Sam put these fractions in order starting with the smallest. Are they in the correct order?
Thirty three fifths

Twenty three thirds
Forty five sevenths
How do you know?

COMPARING DECIMALS

identify the value of each digit in numbers given to three decimal places

Spring: Unit 7

True or false?
In all of the numbers below, the digit 6 is worth more than 6 hundredths.

3.6 3.063 3.006
6.23 7.761
3.076
Is this true or false?
Change some numbers so that it is true.

What needs to be adde3d to 6.543 to give 7?
What needs to be added to 3.582 to give 5?

Circle the two decimals which are closest in value to each other.
0.9 0.09 0.99 0.1 0.01

ROUNDING INCLUDING DECIMALS

solve problems which require answers to be rounded to specified degrees of accuracy

Spring: Unit 7

Do, then explain
Write the answer of each calculation rounded to the nearest whole number
75.7 × 59
7734 ÷ 60
772.4 × 9.7
20.34 × (7.9 – 5.4)

What's the same, what's different?

… when you round numbers to one decimal place and two decimal places?
Also see rounding in place value

EQUIVALENCE (INCLUDING FRACTIONS, DECIMALS AND PERCENTAGES)

use common factors to simplify fractions; use common multiples to express fractions in the same denomination

Autumn: Unit 4

Odd one out.
Which is the odd one out in each of these collections of 4 fraction
s¾ 9/12 26/36 18/24
4/20 1/5 6/25 6/30
Why?
What do you notice?
8/5 of 25 = 40
5/4 of 16 = 20
7/6 of 36 - 42
Can you write similar statements?

associate a fraction with division and calculate decimal fraction equivalents (e.g. 0.375) for a simple fraction (e.g. $^{3}/_{8}$)

Spring: Unit 7

Complete the pattern

$\frac{1}{8}$	$\frac{2}{8}$	$\frac{3}{8}$	$\frac{4}{8}$
0.375	???	???	???

Complete the table.

Another and another Write a unit fraction which has a value of less than 0.5?
… and another, … and another, …

recall and use equivalences between simple fractions, decimals and percentages, including in different contexts.

Spring: Unit 8

Summer: Unit 14

Ordering

Which is larger, $^{1}/_{3}$ or $^{2}/_{5}$?

Explain how you know.

Put the following amounts in order, starting with the largest.

23%, 5/8, 3/5, 0.8

ADDITION AND SUBTRACTION OF FRACTIONS

add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions

Autumn: Units 4 and 5

Another and another

Write down two fractions which have a difference of 1 2/... and another, ... and another, ...

Another and another

Write down 2 fractionswith a total of 3 4/5.

... and another, ... and another, ...

MULTIPLICATION AND DIVISION OF FRACTIONS

multiply simple pairs of proper fractions, writing the answer in its simplest form (e.g. $^1/_4 \times {}^1/_2 = {}^1/_8$)

multiply one-digit numbers with up to two decimal places by whole numbers

Autumn: Unit 5

Spring: Unit 8

divide proper fractions by whole numbers (e.g. $^1/_3 \div 2 = {}^1/_6$)

Autumn: Unit 5

Continue the pattern

1/3 ÷ 2 = 1/6

1/6 ÷ 2 = 1/12

1/12 ÷ 2 = 1/24

What do you notice?

½ x ¼ =

The answer is 1/8 , what is the question (involving fractions / operations)

Give your top tips for dividing fractions.

MULTIPLICATION AND DIVISION OF DECIMALS

multiply one-digit numbers with up to two decimal places by whole numbers

Spring: Unit 7

multiply and divide numbers by 10, 100 and 1000 where the answers are up to three decimal places

Spring: Unit 7

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

Spring: Unit 7

associate a fraction with division and calculate decimal fraction equivalents (e.g. 0.375) for a simple fraction (e.g. $^{3}/_{8}$)

Spring: Unit 7

use written division methods in cases where the answer has up to two decimal places

Autumn: Unit 5

Spring: Unit 7

Undoing

I multiply a number with three decimal places by a multiple of 10. The answer is approximately 3.21
What was my number and what did I multiply buy?

When I divide a number by 1000 the resulting number has the digit 6 in the units and tenths and the other digits are 3 and 2 in the tens and hundreds columns. What could my number have been?

PROBLEM SOLVING

Children explain, prove, justify about decimals

Number: Ratio and Proportion with Reasoning

Year 6

solve problems involving the relative sizes of two quantities where missing values can be found by using integer multiplication and division facts

Spring: Unit 12; Summer Unit: 14

What else do you know?
In a flower bed a gardener plants 3 red bulbs for every 4 white bulbs. How many red and white bulbs might he plant?
If she has 100 white bulbs, how many red bulbs does she need to buy?
If she has 75 red bulbs, how many white bulbs does she need to buy?
If she wants to plant 140 bulbs altogether, how many of each colour should she buy?

Do, then explain
Purple paint is made from read and blue paint in the ratio of 3:5.
To make 40 litres of purple paint how much would I need of each colour? Explain your thinking.

solve problems involving the calculation of percentages [for example, of measures, and such as 15% of 360] and the use of percentages for comparison

Spring: Unit 8; Summer: Units 14 and 15

What else do you know?
88% of a sum of money = £242. Make up some other statements.
Write real life problems for your number sentences.

Undoing
I think of a number and then reduce it by 15%. The number I end up with is 306. What was my original number?

In a sale where everything is reduced by 15% I paid the following prices for three items.
£255, £850, £4.25
What was the original selling price?

solve problems involving similar shapes where the scale factor is known or can be found

Spring: Unit 12

Unpicking
A recipe needs to include three times as much apple than peach. The total weight of apples and peaches in a recipe is 700 grams. How much apple do I need?

solve problems involving unequal sharing and grouping using knowledge of fractions and multiples.

Spring: Unit 12; Summer: Unit 14

Other possibilities

A 50 seater coach travels to the match. Most of the seats are taken.
Junior tickets cost £13 and Adult tickets cost £23.
The only people on the coach are Juniors and Adults.
The total amount paid for tickets is approximately £900
How many people on the coach were adults and how many were juniors?

Number: Algebra with Reasoning

Year 6

EQUATIONS

express missing number problems algebraically

Spring: Unit 9

find pairs of numbers that satisfy number sentences involving two unknowns

Spring: Unit 9

enumerate possibilities of combinations of two variables.

Spring: Unit 9

Connected Calculations

p and q each stand for whole numbers.
p + q = 1000 and p is 150 greater than q.
Work out the values of p and q.

FORMULAE

use simple formulae Spring: Unit 9	*recognise when it is possible to use **formulae** for area and volume of shapes* (copied from Measurement) Spring: Unit 11

Undoing

The diagram below represents two rectangular fields that are next to each other.

Field A	Field B

Field A is twice as long as field B but their widths are the same and are 7.6 metres.
If the perimeter of the small field is 23m what is the perimeter of the entire shape containing both fields?

If y stands for a number complete the table below

y	$3y$	$3y + 1$
25		
		28

What is the largest value of y if the greatest number in the table was 163?

SEQUENCES

generate and describe linear number sequences

Spring: Unit 9

Generalising

Write a formula for the 10^{th}, 100^{th} and nth terms of the sequences below.
4, 8, 12, 16 ……
0.4, 0.8, 1.2, 1.6, ……..

Measurement with Reasoning

Year 6

COMPARING AND ESTIMATING

calculate, estimate and compare volume of cubes and cuboids using standard units, including centimetre cubed (cm^3) and cubic metres (m^3), and extending to other units such as mm^3 and km^3.4

Spring: Unit 11

Top Tips
Put these amounts in order starting with the largest.
100 cm^3
1000000 mm^3
1 m^3
Explain your thinking

Undoing
A film lasting 200 minutes finished at 17:45. At what time did it start?
Other possibilities
(links with geometry, shape and space)
A cuboid has a volume between 200 and 250 cm cubed.
Each edge is at least 4cm long. List four possibilities for the dimensions of the cuboid.

MEASURING and CALCULATING

solve problems involving the calculation and conversion of **units of measure**, using decimal notation up to three decimal places where appropriate
(appears also in Converting)

Summer: Unit 14

Write more statements

Chen, Megan and Sam have parcels. Megan's parcel weighs 1.2kg and Chen's parcel is 1500g and Sam's parcel is half the weight of Megan's parcel. Write down some other statements about the parcels. How much heavier is Megan's parcel than Chen's parcel?

recognise that shapes with the same areas can have different **perimeters** and vice versa

Spring: Unit 11

Testing conditions

A square has the perimeter of 12 cm. When 4 squares are put together, the perimeter of the new shape can be calculated.
For example:

What arrangements will give the maximum perimeter?

calculate the area of parallelograms and triangles

Spring: Unit 11

calculate, estimate and compare volume of cubes and cuboids using standard units, including cubic centimetres (cm^3) and cubic metres (m^3), and extending to other units [e.g. mm^3 and km^3].

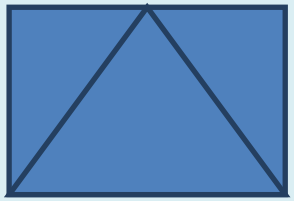
Spring: Unit 11

recognise when it is possible to use formulae for area and volume of shapes

Spring: Unit 11

Always, sometimes, never

The area of a triangle is half the area of the rectangle that encloses it:



See also Geometry Properties of Shape

TELLING THE TIME

Children should be secure in these. Continue to consolidate.

CONVERTING

use, read, write and convert between standard units, converting measurements of length, mass, volume and time from a smaller unit of measure to a larger unit, and vice versa, using decimal notation to up to three decimal places

Spring: Units 10 and 14

solve problems involving the calculation and conversion of units of measure, using decimal notation up to three decimal places where appropriate
(appears also in Measuring and Calculating)

Spring: Unit14

convert between miles and kilometres

Spring: Unit10

The answer is ….

24 metres cubed
What is the question?

What do you notice?8 km = 5 miles
16km = ☐ miles
4 km = ☐ miles
Fill in the missing number of miles.
Write down some more facts connecting kilometres and miles.

Geometry: Properties of Shapes with Reasoning

Year 6

IDENTIFYING SHAPES AND THIER PROPERTIES

recognise, describe and build simple 3-D shapes, including making nets (appears also in Drawing and Constructing) Summer: Unit 13	illustrate and name parts of circles, including radius, diameter and circumference and know that the diameter is twice the radius Summer: Unit 13

What's the same, what's different? What is the same and what is different about the nets of a triangular prism and a square based pyramid?

Visualising
Jess has 24 cubes which she builds to make a cuboid. Write the dimensions of cuboids that she could make.
List all the possibilities.

DRAWING AND CONSTRUCTING

draw 2-D shapes using given dimensions and angles Summer: Unit 13	recognise, describe and build simple 3-D shapes, including making nets (appears also in Identifying Shapes and Their Properties) Summer: Unit 13

Other possibilities
If one angle of an isosceles triangle is 36 degrees.
What could the triangle look like – draw it.
Are there other possibilities .
Draw a net for a cuboid that has a volume of 24 cm^3.

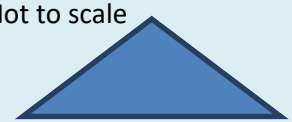
COMPARING AND CLASSIFYING

compare and classify geometric shapes based on their properties and sizes and find unknown angles in any triangles, quadrilaterals, and regular polygons

Summer: Unit 13

Always, sometimes, never
Is it always, sometimes or never true that, in a polyhedron, the number of vertices plus the number of faces equals the number of edges.

Other possibilities
Not to scale



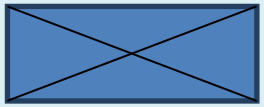
The angle at the top of this isosceles triangle is 110 degrees.
What are the other angles in the triangle?

ANGLES

recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles

Summer: Units 13 and 14

Convince me



One angle at the point where the diagonals of a rectangle meet is 36 degrees.
What could the other angles be?
Convince me

Geometry: Position and Direction with Reasoning

Year 6

POSITION, DIRECTION AND MOVEMENT

describe positions on the full coordinate grid (all four quadrants) Autumn: Unit 6 Summer: Unit 14			draw and translate simple shapes on the coordinate plane, and reflect them in the axes. Autumn: Unit 6		
			plot specified points and draw sides to complete a given polygon Summer: Unit 16		

Working backwards

Two triangles have the following co-ordinates:
Triangle A:
(3, 5) (7, 5) (4, 7)
Triangle B:
(3, 1) (7, 1) (4, 3)
Describe the translation of triangle A to B and then from B to A.

PATTERN

Continue to give children the opportunity to order and arrange combinations of mathematical objects in patterns and sequences.

Statistics with Reasoning

Year 6

INTERPRETING, CONSTRUCTING AND PRESENTING DATA

interpret and construct pie charts and line graphs and use these to solve problems

Summer: Unit 15

True or false?

(Looking at a pie chart) “More than twice the number of people say their favourite type of T.V. programme is soaps than any other”

Is this true or false?
Convince me.
Make up your own ‘true/false’ statement about the pie chart.

What’s the same, what’s different?
Pupils identify similarities and differences between different representations and explain them to each other

SOLVING PROBLEMS

calculate and interpret the mean as an average

Summer: Unit 15

Create a questions Make up a set of five numbers with a mean of 2.7
Missing information

The mean score in six test papers in a spelling test of 20 questions is 15.Five of the scores were 13 12 17 18 16 What was the missing score?