**Secondary Scheme of Work: Stage 7**

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| *Unit* | *Lessons* | *Key ‘Build a Mathematician’ (BAM) Indicators* | *Essential knowledge* |
| [Numbers and the number system](#NNS) | 12 | * [Use positive integer powers and associated real roots](http://kangaroomaths.com/free_resources/assessment/BAM/7M1_BAM.pdf)
* [Apply the four operations with decimal numbers](http://kangaroomaths.com/free_resources/assessment/BAM/7M2_BAM.pdf)
* [Write a quantity as a fraction or percentage of another](http://kangaroomaths.com/free_resources/assessment/BAM/7M3_BAM.pdf)
* [Use multiplicative reasoning to interpret percentage change](http://kangaroomaths.com/free_resources/assessment/BAM/7M4_BAM.pdf)
* [Add, subtract, multiply and divide with fractions and mixed numbers](http://kangaroomaths.com/free_resources/assessment/BAM/7M5_BAM.pdf)
* [Check calculations using approximation, estimation or inverse operations](http://kangaroomaths.com/free_resources/assessment/BAM/7M6_BAM.pdf)
* [Simplify and manipulate expressions by collecting like terms](http://kangaroomaths.com/free_resources/assessment/BAM/7M7_BAM.pdf)
* [Simplify and manipulate expressions by multiplying a single term over a bracket](http://kangaroomaths.com/free_resources/assessment/BAM/7M8_BAM.pdf)
* [Substitute numbers into formulae](http://kangaroomaths.com/free_resources/assessment/BAM/7M9_BAM.pdf)
* [Solve linear equations in one unknown](http://kangaroomaths.com/free_resources/assessment/BAM/7M10_BAM.pdf)
* [Understand and use lines parallel to the axes, y = x and y = -x](http://kangaroomaths.com/free_resources/assessment/BAM/7M11_BAM.pdf)
* [Calculate surface area of cubes and cuboids](http://kangaroomaths.com/free_resources/assessment/BAM/7M12_BAM.pdf)
* [Understand and use geometric notation for labelling angles, lengths, equal lengths and parallel lines](http://kangaroomaths.com/free_resources/assessment/BAM/7M13_BAM.pdf)
 | * [Know the first 6 cube numbers](http://kangaroomaths.com/free_resources/display/number_classification.pdf)
* [Know the first 12 triangular numbers](http://kangaroomaths.com/free_resources/display/number_classification.pdf)
* Know the symbols =, ≠, <, >, ≤, ≥
* [Know the order of operations including brackets](http://kangaroomaths.com/free_resources/display/operations_podium.pdf)
* Know basic algebraic notation
* [Know that area of a rectangle = l × w](http://kangaroomaths.com/free_resources/display/areas.pdf)
* [Know that area of a triangle = b × h ÷ 2](http://kangaroomaths.com/free_resources/display/areas.pdf)
* [Know that area of a parallelogram = b × h](http://kangaroomaths.com/free_resources/display/areas.pdf)
* [Know that area of a trapezium = ((a + b) ÷ 2) × h](http://kangaroomaths.com/free_resources/display/areas.pdf)
* [Know that volume of a cuboid = l × w × h](http://www.kangaroomaths.com/free_resources/display/volumes.pdf)
* Know the meaning of faces, edges and vertices
* [Know the names of special triangles](http://kangaroomaths.com/free_resources/display/triangles.pdf) and [quadrilaterals](http://kangaroomaths.com/free_resources/display/quadrilaterals.pdf)
* [Know how to work out measures of central tendency](http://kangaroomaths.com/free_resources/display/statistics.pdf)
* [Know how to calculate the range](http://kangaroomaths.com/free_resources/display/statistics.pdf)
 |
| [Calculating](#CALC) | 16 |
| [Checking, approximating and estimating](#CAE) | 3 |
| [Counting and comparing](#CC) | 9 |
| [Visualising and constructing](#VC) | 4 |
| [Investigating properties of shapes](#IPS) | 5 |
| [Algebraic proficiency: tinkering](#APT) | 8 |
| [Exploring fractions, decimals and percentages](#EFDP) | 4 |
| [Proportional reasoning](#PR) | 4 |
| [Pattern sniffing](#PS) | 3 |
| [Measuring space](#MS) | 7 |
| [Investigating angles](#IA) | 3 |
| [Calculating fractions, decimals and percentages](#CFDP) | 15 |
| [Solving equations and inequalities](#SEI) | 5 |
| [Calculating space](#CS) | 5 |
| [Mathematical movement](#MM) | 7 |
| [Presentation of data](#PD) | 6 |
| [Measuring data](#MD) | 7 |
| Total: | 123 | [Stage 7 BAM Progress Tracker Sheet](http://kangaroomaths.com/free_resources/planning/stage7_tracker.pdf) |  |

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| **Maths Calendar** | *Based on 7 maths lessons per fortnight, with at least 35 'quality teaching' weeks per year*  |
| Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 | Week 9 | Week 10 | Week 11 | Week 12 | Week 13 |
| [Numbers and the number system](#NNS) | [Calculating](#CALC) | [Checking](#CAE) | [Counting and comparing](#CC) | [Visualising etc](#VC) |  |
| [7M1 BAM](http://kangaroomaths.com/free_resources/assessment/BAM/7M1_BAM.pdf) | [7M2 BAM](http://kangaroomaths.com/free_resources/assessment/BAM/7M2_BAM.pdf) | [7M6 BAM](http://kangaroomaths.com/free_resources/assessment/BAM/7M6_BAM.pdf) |  | [7M13 BAM](http://kangaroomaths.com/free_resources/assessment/BAM/7M13_BAM.pdf) |  |
| Week 14 | Week 15 | Week 16 | Week 17 | Week 18 | Week 19 | Week 20 | Week 21 | Week 22 | Week 23 | Week 24 | Week 25 | Week 26 |
| Assess and enrich | [Properties of shapes](#IPS) | [Algebraic proficiency: tinkering](#APT) | [Exploring FDP](#EFDP) | [Prop'l reasoning](#PR) | [Patterns](#PS) | [Measuring space](#MS) | [Angles](#IA) | [Calculating FDP](#CFDP) |
|  |  | [7M7 BAM](http://kangaroomaths.com/free_resources/assessment/BAM/7M7_BAM.pdf), [7M8 BAM](http://kangaroomaths.com/free_resources/assessment/BAM/7M8_BAM.pdf), [7M9 BAM](http://kangaroomaths.com/free_resources/assessment/BAM/7M9_BAM.pdf) | [7M3 BAM](http://kangaroomaths.com/free_resources/assessment/BAM/7M3_BAM.pdf) |  |  |  |  |  |
| Week 27 | Week 28 | Week 29 | Week 30 | Week 31 | Week 32 | Week 33 | Week 34 | Week 35 | Week 36 | Week 37 | Week 38 | Week 39 |
| Assessment | [Calculating FDP cont'd](#CFDP) | [Solving equations](#SEI) | [Calculating space](#CS) | [Mathematical movement](#MM) | [Presentation of data](#PD) | [Measuring data](#MD) | Assessment |
|  | [7M4 BAM](http://kangaroomaths.com/free_resources/assessment/BAM/7M4_BAM.pdf), [7M5 BAM](http://kangaroomaths.com/free_resources/assessment/BAM/7M5_BAM.pdf) | [7M10 BAM](http://kangaroomaths.com/free_resources/assessment/BAM/7M10_BAM.pdf) | [7M12 BAM](http://kangaroomaths.com/free_resources/assessment/BAM/7M12_BAM.pdf) | [7M11 BAM](http://kangaroomaths.com/free_resources/assessment/BAM/7M11_BAM.pdf) |  |  |  |

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| *Numbers and the number system* | *12 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Number and Place Value progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_NumberPlaceValue.xlsx)  |
| * use the concepts and vocabulary of prime numbers, factors (divisors), multiples, common factors, common multiples, highest common factor and lowest common multiple
* use positive integer powers and associated real roots (square, cube and higher), recognise powers of 2, 3, 4, 5
* recognise and use sequences of triangular, square and cube numbers, simple arithmetic progressions
 |
| [Return to overview](#Overview) |
| Possible key learning points |  | Prerequisites |
| * Find prime numbers and test numbers to see if they are prime
* Find common factors of numbers
* Find the highest common factor of numbers in simple cases, including co-prime examples
* Find common multiples of numbers
* Recognise and solve problems involving the lowest common multiple
* Use linear (arithmetic) number patterns to solve problems
* Recognise and use triangular numbers
* Recognise and use square and cube numbers
 | * Read, write and evaluate powers
* Define and find square roots (including using the $\sqrt{}$ symbol)
* Define and find cube roots (including using the $\sqrt[3]{} $ symbol), including the use of a scientific calculator
* Define and find other roots (including using the$ \sqrt{}$ symbol), including the use of a scientific calculator

KM+ Plan: Review booklets | * Know how to find common multiples of two given numbers
* Know how to find common factors of two given numbers
* Recall multiplication facts to 12 × 12 and associated division facts

KM+ Plan: Check In |
| Pedagogical notes | Mathematical language | Possible misconceptions |
| Pupils need to know how to use a scientific calculator to work out powers and roots.Note that while the square root symbol (√) refers to the positive square root of a number, every positive number has a negative square root too.**Common approaches***The following definition of a prime number should be used in order to minimise confusion about 1: A prime number is a number with exactly two factors.*KM+ Plan: Displays - Number classification postersKM+ Plan: Stage 7 Big Ideas 1 - Use positive integer powers and associated real roots | ((Lowest) common) multiple and LCM((Highest) common) factor and HCFPower(Square and cube) rootTriangular number, Square number, Cube number, Prime numberLinear sequence, Arithmetic sequence**Notation**Index notation: e.g. 53 is read as ‘5 to the power of 3’ and means ‘3 lots of 5 multiplied together’Radical notation: e.g. √49 is generally read as ‘the square root of 49’ and means ‘the positive square root of 49’; 3√8 means ‘the cube root of 8’ | * Many pupils believe that 1 is a prime number – a misconception which can arise if the definition is taken as ‘a number which is divisible by itself and 1’
* A common misconception is to believe that 53 = 5 × 3 = 15
* See pedagogical note about the square root symbol too

KM+ Teach: S07 – SOTM Number relationships (NNS)KM+ Teach: S07 – SOTM Multiples, factors and squares (NNS)KM+ Teach: S07 – BOTM Number relationships (NNS)KM+ Teach: S07 – BOTM Number cards (NNS)KM+ Teach: S07 – BOTM Finding factors (NNS)KM+ Teach: S07 – BOTM Calculating cubes (NNS) |
| Challenging questions | Suggested activities | Assessing understanding |
| * When using Eratosthenes sieve to identify prime numbers, why is there no need to go further than the multiples of 7? If this method was extended to test prime numbers up to 200, how far would you need to go? Convince me.
* Kenny says ’20 is a square number because 102 = 20’. Explain why Kenny is wrong. Kenny is partially correct. How could he change his statement so that it is fully correct?
* Always / Sometimes / Never: The lowest common multiple of two numbers is found by multiplying the two numbers together.
 | KM: [Perfect numbers](http://kangaroomaths.com/free_resources/teaching/number/perfect_numbers.docx)KM: [Exploring primes activities](http://kangaroomaths.com/free_resources/teaching/number/exploring_primes.docx)KM: [Square number puzzle](http://kangaroomaths.com/free_resources/teaching/number/square_number_puzzle.docx)NRICH: [Factors and multiples](http://nrich.maths.org/8149)NRICH: [Powers and roots](http://nrich.maths.org/8706)KM+ Teach: S07 – Primes – Sieve of Eratosthenes (NNS)KM+ Teach: S07 – Primes – Goldbach’s conjectures (NNS)KM+ Teach: S07 – Powers (NNS)KM+ Teach: S07 – Powers – Narcissistic numbers (NNS)KM+ Teach: S07 – Square roots (NNS)KM+ Teach: S07 – Cube roots (NNS) | KM: [7M1 BAM Task](http://kangaroomaths.com/free_resources/assessment/BAM/7M1_BAM.pdf)KM+ Assess: QuestKM+ Assess: What it’s not |

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| *Calculating* | *16 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Calculation progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_NumberCalculation.xlsx) |
| * understand and use place value (e.g. when working with very large or very small numbers, and when calculating with decimals)
* apply the four operations, including formal written methods, to integers and decimals
* use conventional notation for priority of operations, including brackets
* recognise and use relationships between operations, including inverse operations (e.g. cancellation to simplify calculations and expressions)
 |
| [Return to overview](#Overview) |
| Possible key learning points | Prerequisites |
| * Multiply a positive integer by a power of 10
* Multiply a decimal by a power of 10
* Divide a positive integer by a power of 10
* Divide a decimal by a power of 10
* Add numbers up to six-digits using a formal written method
* Add decimals with the same, and different, number of decimal places
* Subtract numbers up to six-digits using a formal written method
* Subtract decimals with the same, and different, number of decimal places
 | * Multiply a number up to four-digits by a one or two-digit number using a formal written method
* Transform a multiplication involving decimals to a corresponding multiplication with integers
* Multiply a large integer up to four-digits by a decimal of up to 2dp using integer multiplication
* Divide a number up to four-digits by a one or two-digit number using a formal written method
* Use a formal method to divide a decimal by an integer < 10
* Use a formal method to divide a decimal by an integer greater than 10
* Transform a calculation involving the division of decimals to an equivalent division involving integers
* Apply the order of operations to multi-step calculations involving up to four operations and brackets

KM+ Plan: Review booklets | * Fluently recall multiplication facts up to 12 × 12
* Fluently apply multiplication facts when carrying out division
* Know the formal written method of long multiplication
* Know the formal written method of short division
* Know the formal written method of long division
* Convert between an improper fraction and a mixed number

KM+ Plan: Check In |
| Pedagogical notes | Mathematical language | Possible misconceptions |
| Note that if not understood fully, BIDMAS can give the wrong answer to a calculation; e.g. 6 – 2 + 3.The grid method is promoted as a method that aids numerical understanding and later progresses to multiplying algebraic statements.KM: [Progression: Addition and Subtraction](http://kangaroomaths.com/free_resources/hod/bouncebuzz_addition_subtraction_v4.pdf), [Progression: Multiplication and Division](http://kangaroomaths.com/free_resources/hod/bouncebuzz_multiplication_division_v4.pdf) and [Calculation overview](http://kangaroomaths.com/free_resources/hod/bouncebuzz_calculation_overview_v4.pdf) **Common approaches***The operations podium is used to explain the order of operations. If an acronym is ever referenced, BIDMAS is used as the I stands for indices.**Long multiplication is promoted as the ‘most efficient method’.* *Short division is promoted as the ‘most efficient method’.*KM+ Plan: Displays – Operations podium, 21 table facts, Chinese tablesKM+ Plan: Stage 7 Big Ideas 2 – Apply the four operations with decimal numbers  | Improper fractionTop-heavy fractionMixed numberOperationInverseLong multiplicationShort divisionLong divisionRemainder | * The use of BIDMAS (or BODMAS) can imply that division takes priority over multiplication, and that addition takes priority over subtraction. This can result in incorrect calculations.
* Pupils may incorrectly apply place value when dividing by a decimal for example by making the answer 10 times bigger when it should be 10 times smaller.
* Some pupils may have inefficient methods for multiplying and dividing numbers.

KM+ Teach: S07 – SOTM Multiplying and dividing by 10, 100, 1000KM+ Teach: S07 – SOTM Multiplying and dividing with decimals**Bring on the Maths+: Moving on up!**Calculating: #2, #3, #4, #5Fractions, decimals & percentages: #6, #7Solving problems: #2 |
| Challenging questions | Suggested activities | Assessing understanding |
| * Jenny says that 2 + 3 × 5 = 25. Kenny says that 2 + 3 × 5 = 17. Who is correct? How do you know?
* Find missing digits in otherwise completed long multiplication / short division calculations
* Show me a calculation that is connected to 14 × 26 = 364. And another. And another …
 | KM: [Long multiplication template](http://kangaroomaths.com/free_resources/teaching/number/long_multiplication_template.docx)KM: [Dividing (lots)](http://kangaroomaths.com/free_resources/teaching/number/dividing_lots.docx)KM: [Interactive long division](http://kangaroomaths.com/free_resources/teaching/number/long_division.xlsx)KM: [Misplaced points](http://kangaroomaths.com/free_resources/teaching/number/misplaced_points.docx)KM: [4 to 1 challenge](http://kangaroomaths.com/free_resources/teaching/number/4to1_%20challenge.pptx)KM: [Maths to Infinity: Multiplying and dividing](http://kangaroomaths.com/free_resources/infinity/multiply_divide.xlsm)NRICH: [Cinema Problem](http://nrich.maths.org/public/viewer.php?obj_id=1864)NRICH: [Funny factorisation](http://nrich.maths.org/740)NRICH: [Skeleton](http://nrich.maths.org/605)NRICH: [Long multiplication](http://nrich.maths.org/635) KM+ Teach: S07 – Tables jigsaw – 10 by 10 Mayan | KM: [7M2 BAM Task](http://kangaroomaths.com/free_resources/assessment/BAM/7M2_BAM.pdf)KM+ Assess: QuestKM+ Assess: What it’s not |

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| *Checking, approximating and estimating* | *3 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Number and Place Value progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_NumberPlaceValue.xlsx) |
| * round numbers and measures to an appropriate degree of accuracy (e.g. to a specified number of decimal places or significant figures)
* estimate answers; check calculations using approximation and estimation, including answers obtained using technology
* recognise and use relationships between operations, including inverse operations (e.g. cancellation to simplify calculations and expressions)
 |
| [Return to overview](#Overview) |
| Possible key learning points | Prerequisites |
| * Round a number to a specified number of decimal places
* Round a number to one significant figure
* Estimate calculations by rounding numbers to one significant figure

KM+ Plan: Review booklets | * Approximate any number by rounding to the nearest 10, 100 or 1000, 10 000, 100 000 or 1 000 000
* Approximate any number with one or two decimal places by rounding to the nearest whole number
* Approximate any number with two decimal places by rounding to the one decimal place
* Simplify a fraction by cancelling common factors

KM+ Plan: Check In |
| Pedagogical notes | Mathematical language | Possible misconceptions |
| Pupils should be able to estimate calculations involving integers and decimals.Also see big pictures: [Calculation progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_NumberCalculation.xlsx) and [Fractions, decimals and percentages progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_NumberFDP.xlsx)**Common approaches***All pupils are taught to visualise rounding through the use a number line*KM+ Plan: Stage 7 Big Ideas 6 – Check calculations using approximation, estimation or inverse operations | Approximate (noun and verb)RoundDecimal placeCheckSolutionAnswerEstimate (noun and verb)Order of magnitudeAccurate, AccuracySignificant figureCancelInverseOperation**Notation**The approximately equal symbol (≈)Significant figure is abbreviated to ‘s.f.’ or ‘sig fig’ | * Some pupils may truncate instead of round
* Some pupils may round down at the half way point, rather than round up.
* Some pupils may think that a number between 0 and 1 rounds to 0 or 1 to one significant figure
* Some pupils may divide by 2 when the denominator of an estimated calculation is 0.5

KM+ Teach: S07 – SOTM Checking and approximating |
| Challenging questions | Suggested activities | Assessing understanding |
| * Convince me that 39 652 rounds to 40 000 to one significant figure
* Convince me that 0.6427 does not round to 1 to one significant figure
* What is wrong: $\frac{11 × 28.2}{0.54}≈\frac{10 × 30}{0.5}=150$. How can you correct it?
 | KM: [Approximating calculations](http://kangaroomaths.com/free_resources/teaching/number/approximating_calculations.docx)KM: [Stick on the Maths: CALC6: Checking solutions](http://www.kangaroomaths.com/free_resources/teaching/sotm/level5/5calc6_ewb.doc)  | KM: [7M6 BAM Task](http://kangaroomaths.com/free_resources/assessment/BAM/7M6_BAM.pdf)KM+ Assess: QuestKM+ Assess: What it’s not |

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| *Counting and comparing* | *9 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Number and Place Value progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_NumberPlaceValue.xlsx) |
| * order positive and negative integers, decimals and fractions
* use the symbols =, ≠, <, >, ≤, ≥
 |
| [Return to overview](#Overview) |
| Possible key learning points | Prerequisites |
| * Use the signs <, > and = to compare numbers
* Use a compound inequality to compare three or more numbers (e.g. -1<0.5<4)
* Order a set of integers
* Order a set of decimals
* Order a set of integers and decimals
* Order fractions with the same denominator or denominators are a multiple of each other
* Order fractions where the denominators are not multiples of each other
* Order mixed numbers and fractions
* Order a combination of integers, decimals, fractions and mixed numbers

KM+ Plan: Review booklets | * Understand that negative numbers are numbers less than zero
* Order a set of decimals with a mixed number of decimal places (up to a maximum of three)
* Order fractions where the denominators are multiples of each other
* Order fractions where the numerator is greater than 1
* Know how to simplify a fraction by cancelling common factors

KM+ Plan: Check InKM+ Teach: S05 – Decimals and Diene’s blocksKM+ Teach: S05 – Decimal ordering cards 1KM+ Teach: S05 – Ordering fractions – Socket setKM+ Teach: S05 – SOTM Ordering temperaturesKM+ Teach: S06 – Decimal ordering cards 2KM+ Teach: S06 – SOTM Ordering decimals |
| Pedagogical notes | Mathematical language | Possible misconceptions |
| Zero is neither positive nor negative. The set of integers includes the natural numbers {1, 2, 3, …}, zero (0) and the ‘opposite’ of the natural numbers {-1, -2, -3, …}.Pupil must use language correctly to avoid reinforcing misconceptions: for example, 0.45 should never be read as ‘zero point forty-five’; 5 > 3 should be read as ‘five is greater than 3’, not ‘5 is bigger than 3’.The equals sign was designed by Robert Recorde in 1557 who also introduced the plus (+) and minus (-) symbols. **Common approaches***Teachers use the language ‘negative number’ to avoid future confusion with calculation that can result by using ‘minus number’**The front of every classroom has a negative number line on the wall.* | Positive numberNegative numberIntegerNumeratorDenominator**Notation**The ‘equals’ sign: =The ‘not equal’ sign: ≠The inequality symbols: < (less than), > (greater than), ≤ (less than or equal to), ≥ (more than or equal to) | * Some pupils may believe that 0.400 is greater than 0.58
* Pupils may believe, incorrectly, that:
* A fraction with a larger denominator is a larger fraction
* A fraction with a larger numerator is a larger fraction
* A fraction involving larger numbers is a larger fraction
* Some pupils may believe that -6 is greater than -3. For this reason ensure pupils avoid saying ‘bigger than’

KM+ Teach: S07 – SOTM Fractions and decimals |
| Challenging questions | Suggested activities | Assessing understanding |
| * Jenny writes down 0.400 > 0.58. Kenny writes down 0.400 < 0.58. Who do you agree with? Explain your answer.
* Find a fraction which is greater than 3/5 and less than 7/8. And another. And another …
* Convince me that -15 < -3
 | KM: [Inequality](http://www.kangaroomaths.com/free_resources/teaching/number/inequality.docx)KM: [Farey Sequences](http://www.kangaroomaths.com/free_resources/teaching/number/farey.pptx)KM: [Decimal ordering cards 2](http://kangaroomaths.com/free_resources/teaching/number/decimal_ordering_cards_2.docx)KM: [Maths to Infinity: Fractions, decimals and percentages](http://kangaroomaths.com/free_resources/infinity/fdprp.xlsm)KM: [Maths to Infinity: Directed numbers](http://kangaroomaths.com/free_resources/infinity/directed_numbers.xlsm)NRICH: [Greater than or less than?](http://nrich.maths.org/10587)YouTube: [The Story of Zero](https://www.youtube.com/watch?v=9Y7gAzTMdMA)KM+ Teach: S07 – Ordering integersKM+ Teach: S07 – Ordering fractions – Farey sequencesKM+ Teach: S07 – Compound inequalitiesKM+ Teach: S07 – InequalityKM+ Teach: S07 – Bubble sort | KM+ Assess: QuestKM+ Assess: What it’s not |

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| *Visualising and constructing* | *4 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Properties of Shape progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_GeometryPropertiesShape.xlsx) |
| * use conventional terms and notations: points, lines, vertices, edges, planes, parallel lines, perpendicular lines, right angles, polygons, regular polygons and polygons with reflection and/or rotation symmetries
* use the standard conventions for labelling and referring to the sides and angles of triangles
* draw diagrams from written description
 |
| [Return to overview](#Overview) |
| Possible themes | Possible key learning points |
| * Interpret geometrical conventions and notation
* Apply geometrical conventions and notation

**Bring on the Maths+: Moving on up!**Properties of shapes: #3, #4 | * Identify line and rotational symmetry in polygons
* Understand and use labelling notation for lengths and angles
* Use ruler and protractor to construct triangles, and other shapes, from written descriptions
* Use ruler and compasses to construct triangles when all three sides known
 |
| Prerequisites | Mathematical language | Pedagogical notes |
| * Use a ruler to measure and draw lengths to the nearest millimetre
* Use a protractor to measure and draw angles to the nearest degree
 | Edge, Face, Vertex (Vertices)PlaneParallelPerpendicularRegular polygonRotational symmetry**Notation**The line between two points A and B is ABThe angle made by points A, B and C is ∠ABCThe angle at the point A is ÂArrow notation for sets of parallel linesDash notation for sides of equal length | NCETM: [Departmental workshop: Constructions](https://www.ncetm.org.uk/resources/10330)The equals sign was designed (by Robert Recorde in 1557) based on two equal length lines that are equidistantNCETM: [Glossary](https://www.ncetm.org.uk/public/files/17308038/National%2BCurriculum%2BGlossary.pdf)**Common approaches***Dynamic geometry software to be used by all students to construct and explore dynamic diagrams of perpendicular and parallel lines.* |
| Reasoning opportunities and probing questions | Suggested activities | Possible misconceptions |
| * Given SSS, how many different triangles can be constructed? Why? Repeat for ASA, SAS, SSA, AAS, AAA.
* Always / Sometimes / Never: to draw a triangle you need to know the size of three angles; to draw a triangle you need to know the size of three sides.
* Convince me that a hexagon can have rotational symmetry with order 2.
 | KM: [Shape work](http://kangaroomaths.com/free_resources/teaching/geometry/shape_work.docx) (selected activities)KM: [Rotational symmetry](http://www.kangaroomaths.com/free_resources/teaching/geometry/rotational_symmetry.docx)NRICH: [Notes on a triangle](http://nrich.maths.org/5920)**Learning review**KM: [7M13 BAM Task](http://kangaroomaths.com/free_resources/assessment/BAM/7M13_BAM.pdf) | * Two line segments that do not touch are perpendicular if they would meet at right angles when extended
* Pupils may believe, incorrectly, that:
* perpendicular lines have to be horizontal / vertical
* only straight lines can be parallel
* all triangles have rotational symmetry of order 3
* all polygons are regular
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| *Investigating properties of shapes* | *5 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Properties of Shape progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_GeometryPropertiesShape.xlsx) |
| * identify properties of the faces, surfaces, edges and vertices of: cubes, cuboids, prisms, cylinders, pyramids, cones and spheres
* derive and apply the properties and definitions of: special types of quadrilaterals, including square, rectangle, parallelogram, trapezium, kite and rhombus; and triangles and other plane figures using appropriate language
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| [Return to overview](#Overview) |
| Possible themes | Possible key learning points |
| * Investigate the properties of 3D shapes
* Explore quadrilaterals
* Explore triangles
 | * Know the connection between faces, edges and vertices in 3D shapes
* Recognise and use nets of 3D shapes
* Know and solve problems using the properties and definitions of triangles
* Know and solve problems using the properties and definitions of special types of quadrilaterals (including diagonals)
* Know and solve problems using the properties of other plane figures
 |
| Prerequisites | Mathematical language | Pedagogical notes |
| * Know the names of common 3D shapes
* Know the meaning of face, edge, vertex
* Understand the principle of a net
* Know the names of special triangles
* Know the names of special quadrilaterals
* Know the meaning of parallel, perpendicular
* Know the notation for equal sides, parallel sides, right angles

**Bring on the Maths+: Moving on up!**Properties of shapes: #1, #2 | Face, Edge, Vertex (Vertices)Cube, Cuboid, Prism, Cylinder, Pyramid, Cone, SphereQuadrilateralSquare, Rectangle, Parallelogram, (Isosceles) Trapezium, Kite, RhombusDelta, ArrowheadDiagonalPerpendicularParallelTriangleScalene, Right-angled, Isosceles, Equilateral**Notation**Dash notation to represent equal lengths in shapes and geometric diagramsRight angle notation | Ensure that pupils do not use the word ‘diamond’ to describe a kite, or a square that is 45° to the horizontal. ‘Diamond’ is not the mathematical name of any shape.A cube is a special case of a cuboid and a rhombus is a special case of a parallelogramA prism must have a polygonal cross-section, and therefore a cylinder is not a prism. Similarly, a cone is not a pyramid.NCETM: [Departmental workshop: 2D shapes](https://www.ncetm.org.uk/resources/12889)NCETM: [Glossary](https://www.ncetm.org.uk/public/files/17308038/National%2BCurriculum%2BGlossary.pdf)**Common approaches***Every classroom has a set of* [*triangle posters*](http://kangaroomaths.com/free_resources/display/triangles.pdf) *and* [*quadrilateral posters*](http://kangaroomaths.com/free_resources/display/quadrilaterals.pdf) *on the wall**Models of 3D shapes to be used by all students during this unit of work*  |
| Reasoning opportunities and probing questions | Suggested activities | Possible misconceptions |
| * Show me an example of a trapezium. And another. And another …
* Always / Sometimes / Never: The number of vertices in a 3D shape is greater than the number of edges
* Which quadrilaterals are special examples of other quadrilaterals? Why? Can you create a ‘quadrilateral family tree’?
* What is the same and what is different: Rhombus / Parallelogram?
 | KM: [Euler’s formula](http://kangaroomaths.com/free_resources/teaching/geometry/eulers_formula.docx)KM: [Visualising 3D shapes](http://kangaroomaths.com/free_resources/teaching/geometry/visualising_3d_shapes.docx)KM: [Complete the net](http://kangaroomaths.com/free_resources/teaching/geometry/complete_net.pptx)KM: [Dotty activities](http://kangaroomaths.com/free_resources/teaching/geometry/3x3_4x4_5x5_dotty_activities.docx): Shapes on dotty paperKM: [What's special about quadrilaterals?](http://kangaroomaths.com/free_resources/teaching/geometry/special_quadrilaterals.docx)  Constructing quadrilaterals from diagonals and summarising results.NRICH: [A chain of polyhedra](https://nrich.maths.org/2316)NRICH: [Property chart](http://nrich.maths.org/2927)NRICH: [Quadrilaterals game](http://nrich.maths.org/2924) | * Some pupils may think that all trapezia are isosceles
* Some pupils may think that a diagonal cannot be horizontal or vertical
* Two line segments that do not touch are perpendicular if they would meet at right angles when extended. Therefore the diagonals of an arrowhead (delta) are perpendicular despite what some pupils may think
* Some pupils may think that a square is only square if ‘horizontal’, and even that a ‘non-horizontal’ square is called a diamond
* The equal angles of an isosceles triangle are not always the ‘base angles’ as some pupils may think
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| *Algebraic proficiency: tinkering* | *8 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Algebra progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_Algebra.xlsx) |
| * understand and use the concepts and vocabulary of expressions, equations, formulae and terms
* use and interpret algebraic notation, including: ab in place of a × b, 3y in place of y + y + y and 3 × y, a² in place of a × a, a³ in place of a × a × a, a/b in place of a ÷ b, brackets
* simplify and manipulate algebraic expressions by collecting like terms and multiplying a single term over a bracket
* where appropriate, interpret simple expressions as functions with inputs and outputs
* substitute numerical values into formulae and expressions
* use conventional notation for priority of operations, including brackets
 |
| [Return to overview](#Overview) |
| Possible themes | Possible key learning points |
| * Understand the vocabulary and notation of algebra
* Manipulate algebraic expressions
* Explore functions
* Evaluate algebraic statements
 | * Know the meaning of expression, term, formula, equation, function
* Know and use basic algebraic notation (the ‘rules’ of algebra)
* Simplify a simple expression by collecting like terms
* Simplify more complex expressions by collecting like terms
* Manipulate expressions by multiplying an integer over a bracket (the distributive law)
* Manipulate expressions by multiplying a single term over a bracket (the distributive law)
* Substitute positive numbers into expressions and formulae
* Given a function, establish outputs from given inputs and inputs from given outputs
 |
| Prerequisites | Mathematical language | Pedagogical notes |
| * Use symbols (including letters) to represent missing numbers
* Substitute numbers into worded formulae
* Substitute numbers into simple algebraic formulae
* Know the order of operations

**Bring on the Maths+: Moving on up!**Algebra: #1 | AlgebraExpression, Term, Formula (formulae), Equation, Function, VariableMapping diagram, Input, OutputRepresentSubstituteEvaluateLike termsSimplify / Collect**Notation**See Key concepts (GCSE subject content statements) above | Pupils will have experienced some algebraic ideas previously. Ensure that there is clarity about the distinction between representing a variable and representing an unknown.Note that each of the statements 4x, 42 and 4½ involves a different operation after the 4, and this can cause problems for some pupils when working with algebra.NCETM: [Algebra](https://www.ncetm.org.uk/resources/43649)NCETM: [Glossary](https://www.ncetm.org.uk/public/files/17308038/National%2BCurriculum%2BGlossary.pdf)**Common approaches***All pupils are expected to learn about the connection between mapping diagrams and formulae (to represent functions) in preparation for future representations of functions graphically.* |
| Reasoning opportunities and probing questions | Suggested activities | Possible misconceptions |
| * Show me an example of an expression / formula / equation
* Always / Sometimes / Never: 4(g+2) = 4g+8, 3(d+1) = 3d+1, a2 = 2a, ab = ba
* [What is wrong?](http://kangaroomaths.com/free_resources/teaching/algebra/multiplying_brackets_wrong.pptx)
* Jenny writes 2a + 3b + 5a – b = 7a + 3. Kenny writes 2a + 3b + 5a – b = 9ab. What would you write? Why?
 | KM: [Pairs in squares](http://kangaroomaths.com/free_resources/teaching/number/pairs_in_squares.docx). Prove the results algebraically.KM: [Algebra rules](http://kangaroomaths.com/free_resources/teaching/algebra/algebra_rules.docx)KM: Use [number patterns](http://kangaroomaths.com/free_resources/teaching/algebra/multiplying_brackets_numerical.pptx) to develop the multiplying out of bracketsKM: [Algebra ordering cards](http://kangaroomaths.com/free_resources/teaching/algebra/algebra_ordering_cards.docx)KM: [Spiders and snakes](http://kangaroomaths.com/free_resources/teaching/algebra/spiders_and_snakes.docx). See the ‘clouding the picture’ approachKM: [Maths to Infinity: Brackets](http://kangaroomaths.com/free_resources/infinity/brackets.xlsm)NRICH: [Your number is …](http://nrich.maths.org/2289)NRICH: [Crossed ends](http://nrich.maths.org/6261)NRICH: [Number pyramids](http://nrich.maths.org/2281) and [More number pyramids](http://nrich.maths.org/2282)**Learning review**KM: [7M7 BAM Task](http://kangaroomaths.com/free_resources/assessment/BAM/7M7_BAM.pdf), [7M8 BAM Task](http://kangaroomaths.com/free_resources/assessment/BAM/7M8_BAM.pdf), [7M9 BAM Task](http://kangaroomaths.com/free_resources/assessment/BAM/7M9_BAM.pdf) | * Some pupils may think that it is always true that a=1, b=2, c=3, etc.
* A common misconception is to believe that a2 = a × 2 = a2 or 2a (which it can do on rare occasions but is not the case in general)
* When working with an expression such as 5a, some pupils may think that if a=2, then 5a = 52.
* Some pupils may think that 3(g+4) = 3g+4
* The convention of not writing a coefficient of 1 (i.e. ‘1x’ is written as ‘x’ may cause some confusion. In particular some pupils may think that 5h – h = 5
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| *Exploring fractions, decimals and percentages* | *4 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Fractions, decimals and percentages progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_NumberFDP.xlsx) |
| * express one quantity as a fraction of another, where the fraction is less than 1 or greater than 1
* define percentage as ‘number of parts per hundred’
* express one quantity as a percentage of another
 |
| [Return to overview](#Overview) |
| Possible themes | Possible key learning points |
| * Understand and use top-heavy fractions
* Understand the meaning of ‘percentage’
* Explore links between fractions and percentages
 | * Write one quantity as a fraction of another where the fraction is less than 1
* Write one quantity as a fraction of another where the fraction is greater than 1
* Write a percentage as a fraction
* Write a quantity as a percentage of another
 |
| Prerequisites | Mathematical language | Pedagogical notes |
| * Understand the concept of a fraction as a proportion
* Understand the concept of equivalent fractions
* Understand the concept of equivalence between fractions and percentages

**Bring on the Maths+: Moving on up!**Fractions, decimals & percentages: #1, #2 | FractionImproper fractionProper fractionVulgar fractionTop-heavy fractionPercentageProportion**Notation**Diagonal fraction bar / horizontal fraction bar | Describe 1/3 as ‘there are three equal parts and I take one’, and 3/4 as ‘there are four equal parts and I take three’.Be alert to pupils reinforcing misconceptions through language such as ‘the bigger half’.To explore the equivalency of fractions make several copies of a diagram with three-quarters shaded. Show that splitting these diagrams with varying numbers of lines does not alter the fraction of the shape that is shaded.NRICH: [Teaching fractions with understanding](http://nrich.maths.org/2550)NCETM: [Teaching fractions](https://www.ncetm.org.uk/resources/44490)NCETM: [Departmental workshop: Fractions](https://www.ncetm.org.uk/resources/13230)NCETM: [Glossary](https://www.ncetm.org.uk/public/files/17308038/National%2BCurriculum%2BGlossary.pdf)**Common approaches***All pupils are made aware that ‘per cent’ is derived from Latin and means ‘out of one hundred’* |
| Reasoning opportunities and probing questions | Suggested activities | Possible misconceptions |
| * Jenny says ‘1/10 is the same as proportion as 10% so 1/5 is the same proportion as 5%.’ What do you think? Why?
* What is the same and what is different: 1/10 and 10% … 1/5 and 20%?
* Show this fraction as part of a square / rectangle / number line / …
 | KM: [Crazy cancelling, silly simplifying](http://kangaroomaths.com/free_resources/teaching/number/crazy_cancelling_silly_simplifying.docx)NRICH: [Rod fractions](http://nrich.maths.org/4345)**Learning review**KM: [7M3 BAM Task](http://kangaroomaths.com/free_resources/assessment/BAM/7M3_BAM.pdf) | * A fraction can be visualised as divisions of a shape (especially a circle) but some pupils may not recognise that these divisions must be equal in size, or that they can be divisions of any shape.
* Pupils may not make the connection that a percentage is a different way of describing a proportion
* Pupils may think that it is not possible to have a percentage greater than 100%
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| *Proportional reasoning* | *4 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Ratio and Proportion progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_RatioProportion.xlsx) |
| * use ratio notation, including reduction to simplest form
* divide a given quantity into two parts in a given part:part or part:whole ratio
 |
| [Return to overview](#Overview) |
| Possible themes | Possible key learning points |
| * Understand and use ratio notation
* Solve problems that involve dividing in a ratio
 | * Describe a comparison of measurements or objects using ratio notation a:b
* Simplify a ratio by cancelling common factors
* Divide a quantity in two parts in a given part:part ratio
* Divide a quantity in two parts in a given part:whole ratio
 |
| Prerequisites | Mathematical language | Pedagogical notes |
| * Find common factors of pairs of numbers
* Convert between standard metric units of measurement
* Convert between units of time
* Recall multiplication facts for multiplication tables up to 12 × 12
* Recall division facts for multiplication tables up to 12 × 12
* Solve comparison problems

**Bring on the Maths+: Moving on up!**Ratio and proportion: #1 | RatioProportionCompare, comparisonPartSimplifyCommon factorCancelLowest termsUnit**Notation**Ratio notation a:b for part:part or part:whole | Note that ratio notation is first introduced in this stage.When solving division in a ratio problems, ensure that pupils express their solution as two quantities rather than as a ratio.NCETM: [The Bar Model](https://www.ncetm.org.uk/resources/44568)NCETM: [Multiplicative reasoning](https://www.ncetm.org.uk/resources/43669)NCETM: [Glossary](https://www.ncetm.org.uk/public/files/17308038/National%2BCurriculum%2BGlossary.pdf)**Common approaches***All pupils are explicitly taught to use the bar model as a way to represent a division in a ratio problem* |
| Reasoning opportunities and probing questions | Suggested activities | Possible misconceptions |
| * Show me a set of objects that demonstrates the ratio 3:2. And another, and another …
* Convince me that the ratio 120mm:0.3m is equivalent to 2:5
* Always / Sometimes / Never: the smaller number comes first when writing a ratio
* Using Cuisenaire rods: If the red rod is 1, explain why d (dark green) is 3. Can you say the value for all the rods? (w, r, g, p, y, d, b, t, B, o). Extend this understanding of proportion by changing the unit rod

e.g. if r = 1, p = ?; b = ?; o + 2B=? If B = 1; y = ? 3y = ?; o = ? o + p = ? If o + r = 6/7; t = ? | KM: [Division in a ratio](http://www.kangaroomaths.com/free_resources/teaching/number/division_in_a_ratio.docx) and [checking spreadsheet](http://www.kangaroomaths.com/free_resources/teaching/number/division_in_a_ratio.xlsx)KM: [Maths to Infinity: FDPRP](http://kangaroomaths.com/free_resources/infinity/fdprp.xlsm)KM: [Stick on the Maths: Ratio and proportion](http://kangaroomaths.com/free_resources/teaching/sotm/level6/6calc2_ewb.doc)NRICH: [Toad in the hole](http://nrich.maths.org/8422)NRICH: [Mixing lemonade](http://nrich.maths.org/6870)NRICH: [Food chains](http://nrich.maths.org/7651)NRICH: [Tray bake](http://nrich.maths.org/7781) | * Some pupils may think that a:b always means part:part
* Some pupils may try to simplify a ratio without first ensuring that the units of each part are the same
* Many pupils will want to identify an additive relationship between two quantities that are in proportion and apply this to other quantities in order to find missing amounts
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| *Pattern sniffing* | *3 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Algebra progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_Algebra.xlsx) |
| * generate terms of a sequence from a term-to-term rule
 |
| [Return to overview](#Overview) |
| Possible themes | Possible key learning points |
| * Investigate number patterns
* Explore number sequences
* Explore sequences
 | * Recognise simple arithmetic progressions
* Use a term-to-term rule to generate a linear sequence
* Use a term-to-term rule to generate a non-linear sequence
 |
| Prerequisites | Mathematical language | Pedagogical notes |
| * Know the vocabulary of sequences
* Find the next term in a linear sequence
* Find a missing term in a linear sequence
* Generate a linear sequence from its description

**Bring on the Maths+: Moving on up!**Number and Place Value: #4, #5 | PatternSequenceLinearTermTerm-to-term ruleAscendingDescending | ‘Term-to-term rule’ is the only new vocabulary for this unit.Position-to-term rule, and the use of the nth term, are not developed until later stages.NRICH: [Go forth and generalise](http://nrich.maths.org/2338)NCETM: [Algebra](https://www.ncetm.org.uk/resources/43649)**Common approaches***All students are taught to describe the term-to-term rule for both numerical and non-numerical sequences* |
| Reasoning opportunities and probing questions | Suggested activities | Possible misconceptions |
| * Show me a (non-)linear sequence. And another. And another.
* What’s the same, what’s different: 2, 5, 8, 11, 14, … and 4, 7, 10, 13, 16, …?
* Create a (non-linear/linear) sequence with a 3rd term of ‘7’
* Always/ Sometimes /Never: The 10th term of is double the 5th term of the (linear) sequence
* Kenny thinks that the 20th term of the sequence 5, 9, 13, 17, 21, … will be 105. Do you agree with Kenny? Explain your answer.
 | KM: [Maths to Infinity: Sequences](http://kangaroomaths.com/free_resources/infinity/sequences.xlsm)KM: [Growing patterns](http://www.kangaroomaths.com/free_resources/teaching/algebra/growing_patterns.docx)NRICH: [Shifting times tables](http://nrich.maths.org/6713)NRICH: [Odds and evens and more evens](http://nrich.maths.org/7529) | * When describing a number sequence some students may not appreciate the fact that the starting number is required as well as a term-to-term rule
* Some pupils may think that all sequences are ascending
* Some pupils may think the (2n)th term of a sequence is double the nth term of a (linear) sequence
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| *Measuring space* | *7 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Measurement and mensuration progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_GeometryMeasurementMensuration.xlsx) |
| * use standard units of measure and related concepts (length, area, volume/capacity, mass, time, money, etc.)
* use standard units of mass, length, time, money and other measures (including standard compound measures) using decimal quantities where appropriate
* change freely between related standard units (e.g. time, length, area, volume/capacity, mass) in numerical contexts
* measure line segments and angles in geometric figures
 |
| [Return to overview](#Overview) |
| Possible themes | Possible key learning points |
| * Measure accurately
* Convert between measures
* Solve problems involving measurement
 | * Use a ruler to accurately measure line segments to the nearest millimetre
* Use a protractor to accurately measure angles to the nearest degree
* Convert fluently between metric units of length
* Convert fluently between metric units of mass
* Convert fluently between metric units of volume / capacity
* Convert fluently between units of time
* Convert fluently between units of money
 |
| Prerequisites | Mathematical language | Pedagogical notes |
| * Convert between metric units
* Use decimal notation up to three decimal places when converting metric units
* Convert between common Imperial units; e.g. feet and inches, pounds and ounces, pints and gallons
* Convert between units of time
* Use 12- and 24-hour clocks, both analogue and digital

**Bring on the Maths+: Moving on up!**Measures: #3 | Length, distanceMass, weightVolumeCapacityMetre, centimetre, millimetreTonne, kilogram, gram, milligramLitre, millilitreHour, minute, secondInch, foot, yardPound, ouncePint, gallonLine segment**Notation**Abbreviations of units in the metric system: m, cm, mm, kg, g, l, mlAbbreviations of units in the Imperial system: lb, oz | Weight and mass are distinct though they are often confused in everyday language. Weight is the force due to gravity, and is calculated as mass multiplied by the acceleration due to gravity. Therefore weight varies due to location while mass is a constant measurement.The prefix ‘centi-‘ means one hundredth, and the prefix ‘milli-‘ means one thousandth. These words are of Latin origin.The prefix ‘kilo-‘ means one thousand. This is Greek in origin.Classify/Estimate angle firstNCETM: [Glossary](https://www.ncetm.org.uk/public/files/17308038/National%2BCurriculum%2BGlossary.pdf)**Common approaches***Every classroom has a sack of sand (25 kg), a bag of sugar (1 kg), a cheque book (1 cheque is 1 gram), a bottle of water (1 litre, and also 1 kg of water) and a teaspoon (5 ml)* |
| Reasoning opportunities and probing questions | Suggested activities | Possible misconceptions |
| * Show me another way of describing 2.5km. And another. And another.
* Show me another way of describing 3.4 litres. And another. And another.
* Show me another way of describing3.7kg. And another. And another.
* Kenny thinks that 14:30 is the same time as 2.30 p.m. Do you agree with Kenny? Explain your answer.
* What’s the same, what’s different: 2 hours 30 minutes, 2.5 hours, 2⅓ hours and 2 hours 20 minutes?
 | KM: [Sorting units](http://kangaroomaths.com/free_resources/teaching/geometry/sorting_units.pptx)KM: [Another length](http://kangaroomaths.com/free_resources/teaching/geometry/another_length.docx)KM: [Measuring space](http://kangaroomaths.com/free_resources/teaching/geometry/measuring_space.pptx)KM: [Another capacity](http://kangaroomaths.com/free_resources/teaching/geometry/another_capacity.docx)KM: [Stick on the Maths: Units](http://kangaroomaths.com/free_resources/teaching/sotm/level5/5ssm6_ewb.doc)NRICH: [Temperature](http://nrich.maths.org/5608) | * Some pupils may write amounts of money incorrectly; e.g. £3.5 for £3.50, especially if a calculator is used at any point
* Some pupils may apply an incorrect understanding that there are 100 minutes in a hour when solving problems
* Some pupils may struggle when converting between 12- and 24-hour clock notation; e.g. thinking that 15:00 is 5 o’ clock
* Some pupils may use the wrong scale of a protractor. For example, they measure an obtuse angle as 60° rather than 120°.
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| *Investigating angles* | *3 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Position and direction progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_GeometryPositionDirection.xlsx) |
| * apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles
 |
| [Return to overview](#Overview) |
| Possible themes | Possible key learning points |
| * Investigate angles

**Bring on the Maths+: Moving on up!**Properties of shapes: #5 | * Recognise and solve problems using vertically opposite angles
* Recognise and solve problems using angles at a point
* Recognise and solve problems using angles at a point on a line
 |
| Prerequisites | Mathematical language | Pedagogical notes |
| * Identify angles that meet at a point
* Identify angles that meet at a point on a line
* Identify vertically opposite angles
* Know that vertically opposite angles are equal
 | AngleDegreesRight angleAcute angleObtuse angleReflex angleProtractorVertically oppositeGeometry, geometrical**Notation**Right angle notationArc notation for all other anglesThe degree symbol (°) | It is important to make the connection between the total of the angles in a triangle and the sum of angles on a straight line by encouraging pupils to draw any triangle, rip off the corners of triangles and fitting them together on a straight line. However, this is not a proof and this needs to be revisited in Stage 8 using alternate angles to prove the sum is always 180°.The word ‘isosceles’ means ‘equal legs’. What do you have at the bottom of equal legs? Equal ankles!NCETM: [Glossary](https://www.ncetm.org.uk/public/files/17308038/National%2BCurriculum%2BGlossary.pdf)**Common approaches***Teachers convince pupils that the sum of the angles in a triangle is 180° by ripping the corners of triangles and fitting them together on a straight line.* |
| Reasoning opportunities and probing questions | Suggested activities | Possible misconceptions |
| * Show me possible values for a and b.

ab40°And another. And another.* Convince me that the angles in a

triangle total 180°* Convince me that the angles in a quadrilateral must total 360°
* What’s the same, what’s different: Vertically opposite angles, angles at a point, angles on a straight line and angles in a triangle?
* Kenny thinks that a triangle cannot have two obtuse angles. Do you agree? Explain your answer.
* Jenny thinks that the largest angle in a triangle is a right angle? Do you agree? Explain your thinking.
 | KM: [Maths to Infinity: Lines and angles](http://kangaroomaths.com/free_resources/infinity/angles_lines.xlsm)KM: [Stick on the Maths: Angles](http://kangaroomaths.com/free_resources/teaching/sotm/level5/5ssm2_ewb.doc)NRICH: [Triangle problem](http://nrich.maths.org/6233)NRICH: [Square problem](http://nrich.maths.org/6265)NRICH: [Two triangle problem](http://nrich.maths.org/7133) | * Some pupils may think it’s the ‘base’ angles of an isosceles that are always equal. For example, they may think that a = b rather than a = c.

abc* Some pupils may make conceptual mistakes when adding and subtracting mentally. For example, they may see that one of two angles on a straight line is 127° and quickly respond that the other angle must be 63°.
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| *Calculating fractions, decimals and percentages* | *15 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Fractions, decimals and percentages progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_NumberFDP.xlsx) |
| * apply the four operations, including formal written methods, to simple fractions (proper and improper), and mixed numbers
* interpret percentages and percentage changes as a fraction or a decimal, and interpret these multiplicatively
* compare two quantities using percentages
* solve problems involving percentage change, including percentage increase/decrease
 |
| [Return to overview](#Overview) |
| Possible themes | Possible key learning points |  |
| * Calculate with fractions
* Calculate with percentages
 | * Add proper and improper fractions
* Add mixed numbers
* Subtract proper and improper fractions
* Subtract mixed numbers
* Multiply proper and improper fractions
* Multiply mixed numbers
* Divide a proper fraction by a proper fraction
* Divide improper fractions
 | * Divide a mixed number by a proper fraction/mixed number
* Identify the multiplier for a percentage increase or decrease
* Use calculators to find a percentage of an amount using multiplicative methods
* Use calculators to increase and decrease an amount by a percentage using multiplicative methods
* Compare two quantities using percentages
* Know that percentage change = actual change ÷ original amount
* Calculate the percentage change in a given situation, including percentage increase / decrease
 |
| Prerequisites | Mathematical language | Pedagogical notes |
| * Add and subtract fractions with different denominators
* Add and subtract mixed numbers with different denominators
* Multiply a proper fraction by a proper fraction
* Divide a proper fraction by a whole number
* Simplify the answer to a calculation when appropriate
* Use non-calculator methods to find a percentage of an amount
* Convert between fractions, decimals and percentages

**Bring on the Maths+: Moving on up!**Fractions, decimals & percentages: #3, #4, #5Ratio and proportion: #2 | Mixed numberEquivalent fractionSimplify, cancel, lowest termsProper fraction, improper fraction, top-heavy fraction, vulgar fractionPercent, percentageMultiplierIncrease, decrease**Notation**Mixed number notationHorizontal / diagonal bar for fractions | It is important that pupils are clear that the methods for addition and subtraction of fractions are different to the methods for multiplication and subtraction. A fraction wall is useful to help visualise and re-present the calculations. NCETM: [The Bar Model](https://www.ncetm.org.uk/resources/44568), [Teaching fractions](https://www.ncetm.org.uk/resources/44490), [Fractions videos](https://www.ncetm.org.uk/resources/43609)NCETM: [Glossary](https://www.ncetm.org.uk/public/files/17308038/National%2BCurriculum%2BGlossary.pdf)**Common approaches***When multiplying a decimal by a whole number pupils are taught to use the corresponding whole number calculation as a general strategy**When adding and subtracting mixed numbers pupils are taught to convert to improper fractions as a general strategy**Teachers use the horizontal fraction bar notation at all times* |
| Reasoning opportunities and probing questions | Suggested activities | Possible misconceptions |
| * Show me a proper (improper) fraction. And another. And another.
* Show me a mixed number fraction. And another. And another.
* Jenny thinks that you can only multiply fractions if they have the same common denominator. Do you agree with Jenny? Explain your answer.
* Benny thinks that you can only divide fractions if they have the same common denominator. Do you agree with Jenny? Explain.
* Kenny thinks that $\frac{6}{10}÷\frac{3}{2}=\frac{2}{5} .$Do you agree with Kenny? Explain.
* Always/Sometimes/Never: To reverse an increase of x%, you decrease by x%
* Lenny calculates the % increase of £6 to £8 as 25%. Do you agree with Lenny? Explain your answer.
 | KM: [Stick on the Maths: Percentage increases and decreases](http://kangaroomaths.com/free_resources/teaching/sotm/level6/6calc1_ewb.doc)KM: [Maths to Infinity: FDPRP](http://kangaroomaths.com/free_resources/infinity/fdprp.xlsm)KM: [Percentage methods](http://kangaroomaths.com/free_resources/teaching/number/percentage_methods.docx)KM: [Mixed numbers: mixed approaches](http://kangaroomaths.com/free_resources/teaching/number/add_subtract_mixed_numbers.docx)NRICH: [Would you rather?](http://nrich.maths.org/1118)NRICH: [Keep it simple](http://nrich.maths.org/6540)NRICH: [Egyptian fractions](http://nrich.maths.org/1173)NRICH: [The greedy algorithm](http://nrich.maths.org/6541)NRICH: [Fractions jigsaw](http://nrich.maths.org/5467)NRICH: [Countdpwn fractions](http://nrich.maths.org/6564)**Learning review**KM: [7M4 BAM Task](http://kangaroomaths.com/free_resources/assessment/BAM/7M3_BAM.pdf), [7M5 BAM Task](http://kangaroomaths.com/free_resources/assessment/BAM/7M5_BAM.pdf) | * Some pupils may think that you simply can simply add/subtract the whole number part of mixed numbers and add/subtract the fractional art of mixed numbers when adding/subtracting mixed numbers, e.g. 3$\frac{1}{3}$ - 2$\frac{1}{2}=1\frac{-1}{6}$
* Some pupils may make multiplying fractions over complicated by applying the same process for adding and subtracting of finding common denominators.
* Some pupils may think the multiplier for, say, a 20% decrease is 0.2 rather than 0.8
* Some pupils may think that percentage change = actual change ÷ new amount
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| *Solving equations and inequalities* | *5 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Algebra progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_Algebra.xlsx) |
| * recognise and use relationships between operations, including inverse operations (e.g. cancellation to simplify calculations and expressions)
* solve linear equations in one unknown algebraically
 |
| [Return to overview](#Overview) |
| Possible themes | Possible key learning points |
| * Explore way of solving equations
* Solve two-step equations
* Solve three-step equations
 | * Solve one-step equations when the solution is a positive integer or fraction
* Solve two-step equations when the solution is a positive integer or fraction
* Solve three-step equations when the solution is a positive integer or fraction
* Solve multi-step equations including the use of brackets when the solution is a positive integer or fraction
* Solve equations when the solution is an integer or fraction
 |
| Prerequisites | Mathematical language | Pedagogical notes |
| * Know the basic rules of algebraic notation
* Express missing number problems algebraically
* Solve missing number problems expressed algebraically

**Bring on the Maths+: Moving on up!**Algebra: #2 | Algebra, algebraic, algebraicallyUnknown EquationOperationSolveSolutionBracketsSymbolSubstitute**Notation**The lower case and upper case of a letter should not be used interchangeably when worked with algebraJuxtaposition is used in place of ‘×’. 2a is used rather than a2.Division is written as a fraction | This unit focuses on solving linear equations with unknowns on one side. Although linear equations with the unknown on both sides are addressed in Stage 8, pupils should be encouraged to think how to solve these equations by exploring the equivalent family of equations such as if 2x = 8 then 2x + 2 = 10, 2x – 3 = 5, 3x = x + 8, 3x + 2 = x + 10, etc.Encourage pupils to re-present the equations such as 2x + 8 = 23 using the Bar Model.NCETM: [The Bar Model](https://www.ncetm.org.uk/resources/44568)NCETM: [Algebra](https://www.ncetm.org.uk/resources/43649), NCETM: [Glossary](https://www.ncetm.org.uk/public/files/17308038/National%2BCurriculum%2BGlossary.pdf)**Common approaches***Pupils could explore solving equations by applying inverse operations, but the expectation is that all pupils should solve by balancing:*

|  |  |  |
| --- | --- | --- |
| x | x | 8 |
| 23 |

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| --- | --- |
| x | x |
| 15 |

|  |
| --- |
| x |
| 7.5 |

|  |  |  |
| --- | --- | --- |
| *2x + 8*  | *=* | *23* |
| *- 8* |  | *- 8* |
| *2x* | *=* | *15* |
| *÷ 2* |  | *2* |
| *x* | *=* | *7.5 (or 15/2)* |

*Pupils are expected to multiply out the brackets before solving an equation involving brackets. This makes the connection with two step equations such as 2x + 6 = 22*  |
| Reasoning opportunities and probing questions | Suggested activities | Possible misconceptions |
| * Show me an (one-step, two-step) equation with a solution of 14 (positive, fractional solution). And another. And another …
* Kenny thinks if 6x = 3 then x = 2. Do you agree with Kenny? Explain
* Jenny and Lenny are solving: 3(x – 2) = 51. Who is correct? Explain

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| ***Jenny’s solution*** | ***Lenny’s solution*** |
| *3(x – 2)*  | *=* | *15* | *3(x – 2)*  | *=* | *15* |
| *÷ 3* |  | *÷ 3* | *Multiplying* | *out* | *brackets* |
| *x - 2* | *=* | *5* | *3x - 6* | *=* | *15* |
| *÷ 2* |  | *÷ 2* | *+2* |  | *+2* |
| *x* | *=* | *7*  | *3x* | *=* | *21*  |
|  |  |  | *÷ 3* |  | *÷ 3* |
|  |  |  | *x =* | *=* | *7* |

 | KM: [Balancing: Act I](http://kangaroomaths.com/free_resources/teaching/algebra/balancing_act_1.docx)KM: [Balancing: Act II](http://kangaroomaths.com/free_resources/teaching/algebra/balancing_act_2.docx)KM: [Balancing: Act III](http://kangaroomaths.com/free_resources/teaching/algebra/balancing_act_3.docx)KM: [Spiders and snakes](http://kangaroomaths.com/free_resources/teaching/algebra/spiders_and_snakes.docx). The example is for an unknown on both sides but the same idea can be used.NRICH: [Inspector Remorse](http://nrich.maths.org/2219)NRICH: [Quince, quonce, quance](http://nrich.maths.org/6199)NRICH: [Weighing the baby](http://nrich.maths.org/6203)**Learning review**KM: [7M10 BAM Task](http://kangaroomaths.com/free_resources/assessment/BAM/7M10_BAM.pdf)  | * Some pupils may think that equations always need to be presented in the form ax + b = c rather than c = ax + b.
* Some pupils may think that the solution to an equation is always positive and/or a whole number.
* Some pupils may get the use the inverse operations in the wrong order, for example, to solve 2x + 18 = 38 the pupils divide by 2 first and then subtract 18.
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| *Calculating space* | *5 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Measurement and mensuration progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_GeometryMeasurementMensuration.xlsx) |
| * use standard units of measure and related concepts (length, area, volume/capacity)
* calculate perimeters of 2D shapes
* know and apply formulae to calculate area of triangles, parallelograms, trapezia
* *calculate surface area of cuboids*
* know and apply formulae to calculate volume of cuboids
* understand and use standard mathematical formulae
 |
| [Return to overview](#Overview) |
| Possible themes | Possible key learning points |
| * Develop knowledge of area
* Investigate surface area
* Explore volume
 | * Calculate perimeters of 2D shapes
* Use and apply the formula to calculate the area of triangles
* Use and apply the formula to calculate the area of trapezia
* Use and apply the formula to calculate the volume of cuboids
* Find the surface area of cuboids (including cubes)
 |
| Prerequisites | Mathematical language | Pedagogical notes |
| * Understand the meaning of area, perimeter, volume and capacity
* Know how to calculate areas of rectangles, parallelograms and triangles using the standard formulae
* Know that the area of a triangle is given by the formula area = ½ × base × height = base × height ÷ 2 = $\frac{bh}{2}$
* Know appropriate metric units for measuring area and volume

**Bring on the Maths+: Moving on up!**Measures: #4, #5, #6 | Perimeter, area, volume, capacity, surface areaSquare, rectangle, parallelogram, triangle, trapezium (trapezia)PolygonCube, cuboidSquare millimetre, square centimetre, square metre, square kilometreCubic centimetre, centimetre cubeFormula, formulaeLength, breadth, depth, height, width**Notation**Abbreviations of units in the metric system: km, m, cm, mm, mm2, cm2, m2, km2, mm3, cm3, km3 | Ensure that pupils make connections with the area and volume work in Stage 6 and below, in particular the importance of the perpendicular height.NCETM: [Glossary](https://www.ncetm.org.uk/public/files/17308038/National%2BCurriculum%2BGlossary.pdf)**Common approaches***Pupils have already derived the formula for the area of a parallelogram. They use this to derive the formula for the area of a trapezium as* $\frac{\left(a+b\right)h}{2}$ *by copying and rotating a trapezium as shown above.**Pupils use the area of a triangle as given by the formula area =* $\frac{bh}{2}$*.**Every classroom has a set of* [*area posters*](http://kangaroomaths.com/free_resources/display/areas.pdf) *on the wall.* |
| Reasoning opportunities and probing questions | Suggested activities | Possible misconceptions |
| * Always / Sometimes / Never: The value of the volume of a cuboid is greater than the value of the surface area
* Convince me that the area of a triangle = ½ × base × height = base × height ÷ 2 = $\frac{bh}{2}$
* (Given a right-angled trapezium with base labelled 8 cm, height 5 cm, top 6 cm) Kenny uses the formula for the area of a trapezium and Benny splits the shape into a rectangle and a triangle. What would you do? Why?
 | KM: [Perimeter](http://kangaroomaths.com/free_resources/teaching/geometry/perimeter.docx)KM: [Triangles](http://kangaroomaths.com/free_resources/teaching/geometry/triangles.docx)KM: [Equable shapes](http://kangaroomaths.com/free_resources/teaching/geometry/equable_shapes.docx) (for both 2D and 3D shapes)KM: [Triangle takeaway](http://kangaroomaths.com/free_resources/teaching/geometry/triangle_takeaway.docx)KM: [Surface area](http://kangaroomaths.com/free_resources/teaching/geometry/surface_area.docx)KM: [Class of rice](http://kangaroomaths.com/free_resources/teaching/geometry/class_of_rice.docx)KM: [Stick on the Maths: Area and Volume](http://www.kangaroomaths.com/free_resources/teaching/sotm/level6/6ssm9_ewb.doc)KM: [Maths to Infinity: Area and Volume](http://www.kangaroomaths.com/free_resources/infinity/area_volume.xlsm)NRICH: [Can They Be Equal?](http://nrich.maths.org/6398)**Learning review**KM: [7M12 BAM Task](http://kangaroomaths.com/free_resources/assessment/BAM/7M12_BAM.pdf) | * Some pupils may use the sloping height when finding the areas of parallelograms, triangles and trapezia
* Some pupils may think that the area of a triangle is found using area = base × height
* Some pupils may think that you multiply all the numbers to find the area of a shape
* Some pupils may confuse the concepts of surface area and volume
* Some pupils may only find the area of the three ‘distinct’ faces when finding surface area
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| *Mathematical movement* | *7 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Position and direction progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_GeometryPositionDirection.xlsx) |
| * work with coordinates in all four quadrants
* *understand and use lines parallel to the axes, y = x and y = -x*
* solve geometrical problems on coordinate axes
* identify, describe and construct congruent shapes including on coordinate axes, by considering rotation, reflection and translation
* describe translations as 2D vectors
 |
| [Return to overview](#Overview) |
| Possible themes | Possible key learning points |
| * Explore lines on the coordinate grid
* Use transformations to move shapes
* Describe transformations
 | * Solve geometrical problems on coordinate axes
* Write the equation of a line parallel to the x-axis or the y-axis
* Identify and draw the lines y = x and y = -x
* Construct and describe reflections in horizontal, vertical and diagonal mirror lines (45° from horizontal)
* Describe a translation as a 2D vector
* Construct and describe rotations using a given angle, direction and centre of rotation
* Solve problems involving rotations, reflections and translations
 |
| Prerequisites | Mathematical language | Pedagogical notes |
| * Work with coordinates in all four quadrants
* Carry out a reflection in a given vertical or horizontal mirror line
* Carry out a translation

**Bring on the Maths+: Moving on up!**Position and direction: #1, #2 | (Cartesian) coordinatesAxis, axes, x-axis, y-axisOriginQuadrantTranslation, Reflection, RotationTransformationObject, ImageCongruent, congruenceMirror lineVectorCentre of rotation**Notation**Cartesian coordinates should be separated by a comma and enclosed in brackets (x, y)Vector notation $\left(\begin{matrix}a\\b\end{matrix}\right)$ where a = movement right and b = movement up | Pupils should be able to use a centre of rotation that is outside, inside, or on the edge of the objectPupils should be encouraged to see the line x = a as the complete (and infinite) set of points such that the x-coordinate is a.The French mathematician Rene Descartes introduced Cartesian coordinates in the 17th century. It is said that he thought of the idea while watching a fly moving around on his bedroom ceiling.NCETM: [Glossary](https://www.ncetm.org.uk/public/files/17308038/National%2BCurriculum%2BGlossary.pdf)**Common approaches***Pupils use ICT to explore these transformations**Teachers do not use the phrase ‘along the corridor and up the stairs’ as it can encourage a mentality of only working in the first quadrant. Later, pupils will have to use coordinates in all four quadrants. A more helpful way to remember the order of coordinates is ‘x is a cross, wise up!’**Teachers use the language ‘negative number’, and not ‘minus number’, to avoid future confusion with calculations.* |
| Reasoning opportunities and probing questions | Suggested activities | Possible misconceptions |
| * Always / Sometimes / Never: The centre of rotation is in the centre of the object
* Convince me that y = 0 is the x-axis
* Always / Sometimes / Never: The line x = a is parallel to the x-axis
 | KM: [Lines](http://kangaroomaths.com/free_resources/teaching/algebra/lines.docx)KM: [Moving house](http://kangaroomaths.com/free_resources/teaching/geometry/moving_house_v1.docx)KM: [Transformations: Bop It?](http://www.kangaroomaths.com/free_resources/teaching/geometry/transformations_bop_it.docx)KM: Dynamic Autograph files: [Reflection](http://www.kangaroomaths.com/free_resources/teaching/geometry/reflect.agg), [Rotation](http://www.kangaroomaths.com/free_resources/teaching/geometry/rotate.agg), [Translation](http://www.kangaroomaths.com/free_resources/teaching/geometry/translate.agg)KM: [Autograph transformations](http://kangaroomaths.com/free_resources/teaching/geometry/autograph_transformations.docx)KM: [Stick on the Maths SSM7: Transformations](http://www.kangaroomaths.com/free_resources/teaching/sotm/level6/6ssm7_ewb.doc)NRICH: [Transformation Game](http://nrich.maths.org/public/viewer.php?obj_id=5457&part=index&refpage=monthindex.php)**Learning review**KM: [7M11 BAM Task](http://kangaroomaths.com/free_resources/assessment/BAM/7M11_BAM.pdf) | * Some pupils will wrestle with the idea that a line x = a is parallel to the y-axis
* When describing or carrying out a translation, some pupils may count the squares between the two shapes rather than the squares that describe the movement between the two shapes.
* When reflecting a shape in a diagonal mirror line some students may draw a translation
* Some pupils may think that the centre of rotation is always in the centre of the shape
* Some pupils will confuse the order of x- and y-coordinates
* When constructing axes, some pupils may not realise the importance of equal divisions on the axes
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| *Presentation of data* | *6 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Statistics progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_Statistics.xlsx)  |
| * interpret and construct tables, charts and diagrams, including frequency tables, bar charts, pie charts and pictograms for categorical data, vertical line charts for ungrouped discrete numerical data and know their appropriate use
 |
| [Return to overview](#Overview) |
| Possible themes | Possible key learning points |
| * Explore types of data
* Construct and interpret graphs
* Select appropriate graphs and charts
 | * Interpret and construct frequency tables
* Construct and interpret bar charts and know their appropriate use
* Construct and interpret comparative bar charts
* Construct and interpret pie charts and know their appropriate use
* Construct and interpret vertical line charts
* Choose appropriate graphs or charts to represent data
 |
| Prerequisites | Mathematical language | Pedagogical notes |
| * Construct and interpret a pictogram
* Construct and interpret a bar chart
* Construct and interpret a line graph
* Understand that pie charts are used to show proportions
* Use a template to construct a pie chart by scaling frequencies

**Bring on the Maths+: Moving on up!**Statistics: #1, #2, #3 | Data, Categorical data, Discrete dataPictogram, Symbol, KeyFrequencyTable, Frequency tableTallyBar chartTime graph, Time seriesBar-line graph, Vertical line chartScale, GraphAxis, axesLine graphPie chartSectorAngleMaximum, minimum**Notation**When tallying, groups of five are created by striking through each group of four | In stage 6 pupils constructed pie charts when the total of frequencies is a factor of 360. More complex cases can now be introduced.Much of the content of this unit has been covered previously in different stages. This is an opportunity to bring together the full range of skills encountered up to this point, and to develop a more refined understanding of usage and vocabulary.William Playfair, a Scottish engineer and economist, introduced the bar chart and line graph in 1786. He also introduced the pie chart in 1801.NCETM: [Glossary](https://www.ncetm.org.uk/public/files/17308038/National%2BCurriculum%2BGlossary.pdf)**Common approaches***Pie charts are constructed by calculating the angle for each section by dividing 360 by the total frequency and not using percentages.**The angle for the first section is measured from a vertical radius. Subsequent sections are measured using the boundary line of the previous section.* |
| Reasoning opportunities and probing questions | Suggested activities | Possible misconceptions |
| * Show me a pie chart representing the following information: Blue (30%), Red (50%), Yellow (the rest). And another. And another.
* Always / Sometimes / Never: Bar charts are vertical
* Always / Sometimes / Never: Bar charts, pie charts, pictograms and vertical line charts can be used to represent any data
* Kenny says ‘If two pie charts have the same section then the amount of data the section represents is the same in each pie chart.’ Do you agree with Kenny? Explain your answer.
 | KM: [Constructing pie charts](http://www.kangaroomaths.com/free_resources/teaching/statistics/constructing_pie_charts.docx)KM: [Maths to Infinity: Averages, Charts and Tables](http://www.kangaroomaths.com/free_resources/infinity/averages_charts_tables.xlsm)NRICH: [Picturing the World](https://nrich.maths.org/10464)NRICH: [Charting Success](http://nrich.maths.org/7735) | * Some pupils may think that the lines on a line graph are always meaningful
* Some pupils may think that each square on the grid used represents one unit
* Some pupils may confuse the fact that the sections of the pie chart total 100% and 360°
* Some pupils may not leave gaps between the bars of a bar chart
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| *Measuring data* | *7 lessons* |
| **Key concepts (GCSE subject content statements)** | **The Big Picture**: [Statistics progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_Statistics.xlsx) |
| * interpret, analyse and compare the distributions of data sets from univariate empirical distributions through appropriate measures of central tendency (median, mean and mode) and spread (range)
 |
| [Return to overview](#Overview) |
| Possible themes | Possible key learning points |
| * Investigate averages
* Explore ways of summarising data
* Analyse and compare sets of data
 | * Find the mode of set of data
* Find the median of a set of data including when there are an even number of numbers in the data set
* Calculate the mean from a frequency table
* Find the mode from a frequency table
* Find the median from a frequency table
* Calculate and understand the range as a measure of spread (or consistency)
* Analyse and compare sets of data, appreciating the limitations of different statistics (mean, median, mode, range)
 |
| Prerequisites | Mathematical language | Pedagogical notes |
| * Understand the meaning of ‘average’ as a typicality (or location)
* Calculate the mean of a set of data

**Bring on the Maths+: Moving on up!**Statistics: #4 | AverageSpreadConsistencyMeanMedianModeRangeMeasureDataStatisticStatisticsApproximateRound | The word ‘average’ is often used synonymously with the mean, but it is only one type of average. In fact, there are several different types of mean (the one in this unit properly being named as the ‘arithmetic mean’). NCETM: [Glossary](https://www.ncetm.org.uk/public/files/17308038/National%2BCurriculum%2BGlossary.pdf)**Common approaches***Every classroom has a set of* [*statistics posters*](http://kangaroomaths.com/free_resources/display/statistics.pdf) *on the wall**Always use brackets when writing out the calculation for a mean, e.g. (2 + 3 + 4 + 5) ÷ 4 = 14 ÷ 4 = 3.5* |
| Reasoning opportunities and probing questions | Suggested activities | Possible misconceptions |
| * Show me a set of data with a mean (mode, median, range) of 5.
* Always / Sometimes / Never: The mean is greater than the mode for a set of data
* Always / Sometimes / Never: The mean is greater than the median for a set of data
* Convince me that a set of data could have more than one mode.
* What’s the same and what’s different: mean, mode, median, range?
 | KM: [Maths to Infinity: Averages](http://kangaroomaths.com/free_resources/infinity/averages.xls)KM: [Maths to Infinity: Averages, Charts and Tables](http://www.kangaroomaths.com/free_resources/infinity/averages_charts_tables.xlsm)KM: [Stick on the Maths HD4: Averages](http://www.kangaroomaths.com/free_resources/teaching/sotm/level5/5hd4_ewb.doc)NRICH: [M, M and M](http://nrich.maths.org/6267)NRICH: [The Wisdom of the Crowd](http://nrich.maths.org/9601) | * If using a calculator some pupils may not use the ‘=’ symbol (or brackets) correctly; e.g. working out the mean of 2, 3, 4 and 5 as 2 + 3 + 4 + 5 ÷ 4 = 10.25.
* Some pupils may think that the range is a type of average
* Some pupils may think that a set of data with an even number of items has two values for the median, e.g. 2, 4, 5, 6, 7, 8 has a median of 5 and 6 rather than 5.5
* Some pupils may not write the data in order before finding the median.
 |