• Basic number rules
  
  ○ **Times tables**
  Quick recall of multiplication facts including use of finger strategies, rhymes etc. Include both multiplication and derivation of associated division facts
  
  ○ **Order of operations**
  Calculate the value of an expression by prioritising the operations
  
  ○ **Add and subtract tens and hundreds**
  Count on and back in tens or hundreds from any two- or three-digit number. Add or subtract mentally a one-digit number or a multiple of 10 to or from any two-digit number and develop to multiples of 100
  
  ○ **Continue number sequences**
  Recognise and continue number sequences formed by counting on or back in steps of constant size from any integer, extending to negative integers when counting back. Count from any given number in whole-number and decimal steps, extending beyond zero when counting backwards; relate the numbers to their position on a number line
  
  ○ **Rational and irrational numbers**
  Australian teaching objective
  
  ○ **Understanding the ×2, ×3, ×4 and ×5 times tables**
  Recall times table results for ×2, ×3, ×4 and ×5 times tables, each up to a multiple of 12
  
  ○ **Understanding the ×6, ×7, ×8 and ×9 times tables**
  Recall times table results for ×6, ×7, ×8 and ×9 times tables, each up to a multiple of 12
  
  ○ **Understanding the ×10, ×11 and ×12 times tables**
  Recall times table results for ×10, ×11 and ×12 times tables, each up to a multiple of 12
  
  ○ **Understanding the ×13, ×14 and ×15 times tables**
  Recall times table results for ×13, ×14 and ×15 times tables, each up to a multiple of 15

• Fractions

  ○ **Write one number as a fraction of another**
  Understand the role of the numerator and denominator. Express an amount as part of a whole or relative to another amount including the concept of the numerator and denominator being equal to make the fraction have a value of 1
  
  ○ **Mixed numbers and top heavy fractions**
  Understand how to change between mixed and top heavy fractions. Understand the link in terms of diagrams
  
  ○ **Simplify fractions**
  Understand that only multiplication and division can be applied to the numerator and denominator to achieve equal fractions. Change a fraction to its simplest form
  
  ○ **Order decimals and fractions**
  Put fractions in order of size or compare them by converting to a common denominator or by considering them relative to a half in order to split the list into two parts for separate comparison. Also order a list of fractions and decimals with or without a calculator
  
  ○ **Add and subtract fractions**
  Add and subtract any type of fraction including vulgar and mixed. Understand why a common denominator is needed and how to decide on what to use. Use any denominator
All Prodigi Lessons

- Multiply with fractions
  Multiply any type of fractions together. Include cancelling common factors prior to multiplication. Also increase or decrease an integer or fraction by a certain fraction, including a fraction to a positive integer power.

- Find a fraction of an amount - whole number answers
  Understand division followed by multiplication will calculate a fractional part of an amount. Restrict to examples where the answer is an integer.

- Find a fraction of an amount
  Understand both division followed by multiplication and fractional multiplication will find the solution. Include fractional solutions.

- Division with fractions
  Divide any type of fraction by another fraction. Include an integer by a fraction and a fraction by an integer. Understand that this is the inverse of multiplication.

- Repeated fractional change
  Find the result of a repeated fractional change using both calculator and non calculator methods.

- Reciprocals
  Find the reciprocal of a fraction, integer or decimal and use it as an inverse operation. Know that any number multiplied by its reciprocal equals 1.

- Change fractions into percentages and decimals
  Change a fraction to an equivalent form with a denominator of a power of 10 and relate this to the place value of the decimals. Also, change a fraction to a decimal using short division. Use an equivalent fraction with a denominator of 100 to convert to a percentage. Order amounts expressed in all three forms. Decide on a suitable method of comparison including converting to a common form or a more heuristic approach, e.g. separating into 2 groups, those greater and those less than a half before ordering.

- Common fractions
  Familiarity with the common decimal and percentage equivalents of fractions with denominators of 2, 4, 10, 100.

- Common fractions - thirds and fifths
  Familiarity with the common decimal and percentage equivalents of fractions with denominators of 3 and 5.

- Common fractions - eighths
  Familiarity with the common decimal and percentage equivalents of fractions with a denominator of 8.

- Common fractions - sixths
  Familiarity with the common decimal and percentage equivalents of a fractions with a denominators of 6.

- Decimals
  - Add and subtract decimals
    Adding and subtracting decimals including missing digits in the calculation. Use any number of decimal places in either number.
  
  - Multiply and divide decimals by 10, 100, 1000
    Understand that digits are moved in their place value when you multiply and divide by a power positive power of ten.
  
  - Multiply by a decimal
    Multiplying with a single digit and a simple decimal e.g. 7 multiplied by 0.3.
  
  - Multiply decimals
    Multiplying an integer or decimal by a decimal. Understand where to put the decimal point after converting the question to an integer multiplication. Understand the effect of multiplying or dividing an integer or decimal by 0.1, 0.01 i.e. that it is equivalent to either a division or multiplication by 10, 100 etc. Include finding a decimal of an...
All Prodigy Lessons

- **Divide with decimals**
  Divide an amount by a decimal by converting to an equivalent, simpler division by an integer. Include examples where the number to be divided is a decimal

- **Use a decimal calculation**
  Given the result of a multiplication or division find the result of a related problem by understanding how the numbers have changed. e.g. Given that $6 \times 7 = 42$ find $0.6 \times 7$ or given $38.2 \times 42 = 1604.4$ find $160.44 / 4.2$

- **Multiply and divide by a number between 0 and 1**
  Understand the effects of multiplying and dividing an integer or decimal by a number between 0 and 1 (non-inclusive)

- **Change decimals into percentages and fractions**
  Understand that decimals are fractions with denominators of 10, 100 etc and understand how the place value of decimals relates to percentages. Order amounts expressed in all three forms. Decide on a suitable method of comparison including converting to a common form or a more heuristic approach, e.g. separating into 2 groups, those greater and those less than a half before ordering

- **Change recurring decimals to fractions**
  Change a recurring decimal to a fraction using algebra and understand the dot notation

- **Percentages**
  - **Change percentages into fractions and decimals**
    Understand that a percentage is a fraction with a denominator of 100 and understand how the place value of a percentage relates to a decimal place value. Order amounts expressed in all three forms. Decide on a suitable method of comparison including converting to a common form or a more heuristic approach, e.g. separating into 2 groups, those greater and those less than a half before ordering
  - **Find percentages - no calculator**
    Find a percentage of an amount using short cut strategies, especially 10% and 1% to find other percentages
  - **Find percentages - calculator**
    Understand that multiplication by the decimal equivalent of a percentage gives the required percentage of the amount
  - **Percentage increase and decrease - no calculator**
    Use short cut strategies, especially 10% and 1% to find other percentages and carry out the required percentage increase or decrease. Include the terms appreciate and depreciate
  - **Percentage increase and decrease - calculator**
    Use a single decimal multiplication to perform a percentage increase or decrease
  - **Find one amount as a percentage of another - no calculator**
    Find one amount as a percentage of another by converting the question to a fraction with a denominator of 100
  - **Find one amount as a percentage of another - calculator**
    Find one amount as a percentage of another amount by understanding which way to perform the division and that the result is the decimal expression of the percentage answer
  - **Find the percentage change - no calculator**
    When finding the percentage change, convert the question to a fraction with a denominator of 100 understanding that the solution is always out of the ‘original/true’ value. Include percentage profit/loss/depreciation/appreciation
  - **Find the percentage change - calculator**
    When finding percentage change, understand which way to perform the division and that the result is the decimal expression of the answer. Understand which amount is to be taken as the original
All Prodigi Lessons

- **Reverse percentages - no calculator**
  Find the original amount or change in original amount using written strategies especially ratio to equate an amount with the percentage it represents

- **Reverse percentages - calculator**
  Find the original amount or change in original amount by using the inverse operation that caused the percentage change e.g. division by 1.175 to remove VAT

- **Repeated percentage change**
  Understand that the new amount has to be calculated before next interest can be added on with compound interest. Use short cut methods to find the required percentage, especially 10% and 1%

- **Calculations with whole numbers (Integers)**
  - **Multiply and divide whole numbers by 10, 100 and 1000**
    When multiplying and dividing by a power of ten, understand that the digits are moved by adding or removing zeros or moving the decimal point
  - **Quick methods for multiplication**
    Use short cut strategies to multiply e.g. 19 times a number is 20 times the number subtract the number
  - **Quick methods for division**
    Use short cut strategies to divide e.g. division by 5 is division by 10 followed by doubling
  - **Adjust one calculation to find another**
    Given the result of a multiplication or division find the result of a related problem by understanding how the numbers have changed. Simple examples e.g. 6×7=42 so find 60×7
  - **Use a calculation**
    Given the result of a multiplication or division find the result of a related problem by understanding how the numbers have changed. Use complex examples e.g. 382×420=160440 find 16044/42

- **Money Management**
  - **Money Management**
    Understand what is meant by inflation and solve problems involving inflation. Understand what is meant by VAT and know the current rate and that some goods are excluded from VAT and that some people do not have to pay VAT. Solve problems involving VAT. Use tax brackets and personal allowances as well as extra payments to calculate wages. Make particular use of percentages. Perform calculations that allow you to compare different financial products. Include hire purchase and buy now pay later schemes. Read utility meters and calculate bills including different rates of charge at different times of the day
  - **Cash and credit card payments**
    Australian teaching objective
  - **Wages and salary**
    Australian teaching objective
  - **Different types of income**
    Australian teaching objective
  - **Net and Gross pay**
    Australian teaching objective
• Ratio and proportion

○ Ratios
Understand very simple ratio to compare two amounts where the ratio will be given in the question. Also, find ratios of amounts to each other and simplify. Units will be the same each time.

○ Working with ratios
Find ratios of amounts to each other and simplify. Units can be different and will need eliminating. Change ratio into different forms, include 1:n, n:1 and other forms to allow the comparison of two ratios

○ Use double ratios
Understand that an amount is to be split into the sum of the parts of the ratio. Use only a double and not a triple ratio

○ Use triple ratios
Understand that an amount is to be split into the sum of the parts of the ratio. Use triple ratios

○ Solving problems with ratios
Solve ratio problems where you do not know the full amount but are given other information. e.g. You are given the amount of one part of the ratio and have to find the original amount

○ Ratio and proportion - drawings and models
Use ratio in a practical context including map scales, drawings, models, paper sizes and gear ratios. Including giving the scale in various forms that are commonly used e.g. 1:50 000 in maps

• Negative numbers

○ Add and subtract with negatives
Perform addition and subtraction with negative and positive combinations

○ Multiply and divide with negatives
Perform multiplication and division with negative and positive combinations and understand why operations involving 2 negatives will produce a positive solution. Understand the idea of reflection on the number line caused by multiplication or division by -1

• Rounding, accuracy and estimation

○ Round to the nearest unit, 10, 100 and 1000
Round to positive powers of 10 e.g. 100,10, kilometre (when measure is expressed in metres). Include examples of decimals (both between 0-1 and greater than 1) rounded to the nearest integer

○ Round to the nearest tenth, hundredth and thousandth
Round to powers of ten below units e.g. 0.01, tenth, penny (when a measure is in pounds), hundredth

○ Round using decimal places
Round to a specified number of decimal places

○ Round using significant figures
Round to a specified number of significant figures

○ Estimates and approximations
Round figures to a sensible degree of accuracy, normally 1s.f. before calculating to give an estimate of a calculation. Include examples that incorporate both integers and decimals

○ Upper and lower bounds
Maximum and minimum values on discrete and continuous data applied to problems. Calculate with bounds on a calculation. Include does it fit practical problems by consideration of the extreme possible bounds
All Prodigi Lessons

- Leave answers as roots
  Leave answers in surds (unsimplified surds) and understand that a surd is a valid solution to a question

- Check answers using approximations
  Check that a calculation gives an answer of the correct size by using simple approximations and inverse operations if needed

- Factors, multiples and primes
  - Factors and multiples
    Find factors and multiples of a number including listing factors in pairs to find all the factors of large numbers. Find common multiples and lowest/least common multiples without the use of the Product of Prime Factors, simple cases only. Find common factors and highest common factor (HCF), including using the term divisor and use given results as an aid e.g. 36=18x2. Simple cases only
  - Prime numbers
    Understand the definition of a prime number as an integer with exactly 2 factors and be able to test for a number being prime. Know that 2 is the first prime number and the only even prime number
  - Product of prime factors
    Know the terms product of prime factors and prime factor decomposition. Use a factor tree or similar method to decompose numbers including writing the answer in index form
  - Least common multiple and highest common factor
    Use the product of prime factors to find the HCF or LCM of numbers. Draw a Venn diagram to illustrate the prime factors. Use other results that are given in the question

- Special number sequences
  - Square numbers
    Recognise and calculate the square number sequence up to 144 and also include simple higher values, e.g. 400, 10000. Understand the square roots as the reverse process of squaring. Only consider positive square roots
  - Cube numbers
    Recognise and calculate the cube number sequence up to 216 and also include simple higher values, e.g. 8000.
  - Special number sequences
    Recognise and generate the Fibonacci sequence and triangle numbers. Explore other sequences.
  - Advanced special number sequences
    Australian teaching objective

- Standard form
  - Change between standard form and ordinary numbers
    Change standard form numbers into ordinary numbers and visa versa. Deal with both large and small numbers and understand the importance of counting the number of places rather than the number of zeros
  - Standard form problems without a calculator
    Australian teaching objective

- Indices
Positive powers
Understand the pattern of results found from the positive integer powers, i.e. the continuing division of successive results as the power reduces by 1 and continued multiplication as the power increases by 1. Spot patterns in the sequence, e.g. in the units digit. Know the terms square (squared) and cube (cubed). Understand what is meant by a number to any positive integer power.

Negative powers
Understand the pattern of results found from the positive integer, zero and negative integer powers, i.e. the continuing division of successive results as the power reduces by 1, leading to reciprocals. Understand that 0.1, 1/10 and $10^{-1}$ are equivalent.

Square and cube roots
Understand that there is a positive and negative square root but that this does not apply to a cube root. Recall up to the square root of 225 square root, including approximating square roots and recall up to the cube root of 125, including approximating cube roots. Understand it is invalid to square root a negative and know the positive root sign. Recognise the symbols and the words for square and cube root.

Roots
Use power roots above cubed. Know the meaning and evaluate them without a calculator.

Use powers and roots
Understand that powers and power roots are inverse operations and use this property to solve problems.

Rules of indices, add and subtract the powers
Use the indices rules for adding and subtracting the powers. Include both algebraic and non-algebraic examples.

Rules of indices, multiply the powers
Use the indices rule for the multiplication of the powers. Include both algebraic and non-algebraic examples. Also incorporate the addition and subtraction rules into the questions.

Indices and roots
Understand that when a power is a unit fraction the denominator is an instruction to take the power root of the number.

Laws of indices and fractional powers
Understand the meaning of the numerator and denominator of a fractional power. Include vulgar/mixed fractions and decimals.

Roots of products of prime factors
Australian teaching objective.

- Time, timetables and charts
  - Time calculations
    Know the conversion factors for time measured in seconds, minutes, hours, days, weeks, months, years and express times in different units both with and without a calculator including decimals or fractions of a time unit.
  - Timetables and charts
    Read and write the time in 12 and 24 hour clock. Find the difference between two times. Read information from charts deciding what information is and is not required. Include 2 way distance/price charts and timetables in 12 and 24 hour clock.
  - Time zones
    Australian teaching objective.

- Proof
All Prodigi Lessons

- **Proofs**
  Use a counter example to disprove a statement or examples to justify a statement, especially prime, integer, odd and even problems

- **Algebraic proofs**
  Use formal descriptive and algebraic proofs for odds, evens, consecutives, factors, multiples(divisible by) etc

• **Surds**
  - **Simplify square roots**
    Split a square root into the product of 2 appropriate square roots in order to write in its simplest form
  - **Add and subtract surds**
    Simplify square roots in order to help add and subtract like surd terms
  - **Multiply surds**
    Multiply surds including over a single or double bracket
  - **Rationalise a denominator**
    Understand what operation to perform to the numerator and denominator of a fraction in order to rationalise the denominator. Perform further simplification
  - **Solve problems using surds**
    Use surd manipulation to solve practical problems without a calculator, e.g. Pythagoras

• **Using number facts**
  - **Recognise square numbers**
    Use knowledge of multiplication facts to derive quickly squares of numbers to 12 × 12 and the corresponding squares of multiples of 10
  - **Find prime factors**
    Find the prime factors of two-digit numbers
  - **Identify factor pairs**
    Identify pairs of factors of two-digit whole numbers and find common multiples (e.g. for 6 and 9)

• **Understanding the number system**
  - **Recognise place value**
    Read, write and order whole numbers, recognising that the position of a digit gives its value and understand the place value of each digit up to 1000
  - **Round integers**
    Round integers to the nearest 10 or 100 and then 1000
  - **Use negative numbers**
    Use positive and negative numbers in context such as temperature and position them on a number line; state inequalities using the symbols < and > (e.g. -3 > -5, -1 < 1) Find the difference between a positive and a negative integer, or two negative integers, in context
  - **Read and write numbers up to 10**
    Recognise, count and read numbers up to 10 using words, digits and pictures
  - **Read and write numbers up to 100**
    Recognise, count and read numbers up to 100 using words, digits and pictures
- **Read and write numbers up to 1000**
  Recognise, count and read numbers up to 1000 using words, digits and pictures

- **Putting whole numbers in order up to 100**
  Decide which of two numbers from 1 to 100 is the larger. From a list of integers up to 100, arrange in ascending or descending order.

### Fractions, percentages and ratio

- **Identify halves and quarters**
  Find one half, one quarter and three quarters of shapes and sets of objects

- **Use fractions**
  Read and write proper fractions, interpreting the denominator as the parts of a whole and the numerator as the number of parts; identify and estimate simple fractions of shapes

- **Find a fraction of an amount**
  Find a fraction of a number using division and multiplication. e.g. Find 3/8 of 32

- **Equivalent fractions**
  Use diagrams to identify equivalent fractions (e.g. 6/8 and 3/4, or 7/10 and 70/100); interpret mixed numbers and position them on a number line (e.g. 3 1/2) simplify fractions by cancelling common factors

- **Relate fractions and decimals**
  Relate fractions to their decimal representations

- **Order fractions**
  Order a set of fractions by converting them to fractions with a common denominator

- **Understand percentages**
  Understand percentage as the number of parts in every 100 and express tenths and hundredths as percentages

- **Use percentages**
  Find percentages of numbers and quantities (e.g. 10%, 5% and 15% of 80p)

- **Recognise proportions**
  Recognise approximate proportions of a whole and use simple fractions and percentages to describe them, explaining their methods and reasoning

- **Use proportion**
  Solve simple problems involving direct proportion by scaling quantities up or down

### Understanding decimals

- **Recognise tenths and hundredths**
  Understand and use decimal notation for tenths and hundredths in context [for example, order amounts of money, round a sum of money to the nearest pound, convert a length such as 1.36 metres to centimetres and vice versa]

- **Order decimals**
  Use decimal notation for tenths, hundredths and thousandths; partition and order decimals with up to three places, and position them on the number line

- **Round decimals**
  Round decimals with up to three places
All Prodigi Lessons

- Number operations and the relationships between them
  - Use inverses
    Understand that halving is the inverse of doubling and derive and recall doubles of all numbers to 20, and the corresponding halves. Understand that subtraction is the inverse of addition and vice versa; use this to derive and record related addition and subtraction number sentences.
  - Choose the correct operation
    Choose suitable number operations to solve a given problem, and recognise similar problems to which they apply.
  - Find remainders after division
    Find remainders after division, then express a quotient as a fraction or decimal.
  - Deal with remainders
    Round up or down after division, depending on the context.
  - Use brackets
    Understand the use of brackets to determine the order of operations.
  - Relate addition to multiplication
    Understand why the commutative, associative and distributive laws apply to addition and multiplication and how they can be used to do mental and written calculations more efficiently.

- Mental methods
  - Number partners up to 20
    Recall all addition and subtraction facts for each number to 20. Use this to solve problems involving small or large numbers.
  - Number pairs up to 100
    Derive and recall all number pairs that total 100. Add or subtract mentally pairs of two-digit whole numbers (e.g. 47 + 58, 91 - 35).
  - Mental addition and subtraction of large numbers
    Extend mental-methods for whole-number calculations, for example to subtract one near-multiple of 1000 from another (e.g. 6070 - 4097).
  - Doubling and halving
    Double and halve any two-digit number.
  - Mental multiplication and division
    Extend mental-methods for whole-number calculations with multiplication and division. For example to multiply a two-digit by a one-digit number, 12 × 9, work out 12 × 10 then subtract 12.
  - Mental multiplication and division with decimals
    Derive related division and multiplication facts involving decimals (e.g. 0.8 × 7) from 8 × 7.

- Written methods
  - Addition and subtraction
    Australian teaching objective.
  - Addition and subtraction - column method
    Use efficient written methods to add and subtract whole numbers up to 1000.
Addition and subtraction of decimals
Use efficient written methods to add and subtract decimals with up to two places

Check calculations
Use knowledge of rounding, place value, number facts, divisibility test and inverse operations to check calculations are correct or are approximately correct

Division
Australian teaching objective

Short division
Refine and use efficient written methods to divide HTU by U. Use efficient written methods to divide integers and decimals by a one-digit integer

Multiplication
Australian teaching objective

Long multiplication
Refine and use efficient written methods to multiply HTU × U, TU × TU

Multiply decimals and larger numbers
Use efficient written methods to multiply integers and decimals by a one-digit integer, and to multiply two-digit and three-digit integers by a two-digit integer

Estimation
Estimate the result of a calculation by using sensible rounding

Calculator methods

Calculator problems - decimals
Use a calculator to solve problems, including those involving decimals

Calculator problems
Use a calculator to solve number problems [for example, 4? x 7 = 343]

Calculator problems - fractions
Use a calculator to solve problems, including fractions (e.g. find 3/4 of 150 g)

Calculator problems - measurement and money
Use a calculator to solve problems; interpret the display correctly in the context of measurement

Use a calculator - brackets and memory
Use bracket keys and the memory of a calculator to carry out calculations with more than one step

Solving numerical problems

Solve word problems
Choose, use and combine any of the four number operations to solve word problems involving numbers in 'real life', perimeter and area (note, knowing how to find perimeter and area is not required, a question should always 'tell' you the meaning of area and perimeter)

Solve word problems - money and measurement
Choose, use and combine any of the four number operations to solve word problems involving numbers in 'real life', money or measures of length, mass, capacity or time
**Bidmas Blaster**
- **Addition & subtraction**
  Add and subtract with 2 or 3 numbers using single and double digits.

- **Brackets, multiplication & division**
  Multiply and divide with 2 or 3 numbers using times table facts and mental strategies.

- **Brackets & the 4 operations**
  Use the order of operations rules for addition, subtraction, multiplication and division. Include solving problems involving brackets.

- **Introducing powers & roots**
  Use the order of operations rules for addition, subtraction, multiplication, division, squares, cubes, square roots and cube roots. Include solving problems involving brackets. Limit to 2 operations.

- **Full BIDMAS: all operations**
  Use the order of operations rules for addition, subtraction, multiplication, division, powers and roots. Include solving problems involving 1 or 2 sets of brackets. Limit to 3 operations.

**Bidmas Blaster Lite**
- **Using addition**
  Add with two numbers using single and double digits.

- **Using subtraction**
  Subtract with two numbers using single and double digits.

- **Using multiplication**
  Multiply with two numbers using times tables up to 12.

- **Using division**
  Divide with two numbers using times tables results up to 12. Also, divide large numbers by 2, 3, 4 and 5.

- **The four operations**
  Use all four operations with single and double digit numbers.

**Flower Power**
- **Ordering decimals**
  Order integers and decimals that are written to 1 decimal place.

- **Ordering fractions: halves & quarters**
  Order integers and proper and improper fractions that have a denominator of 2 or 4.

- **Ordering general fractions**
  Order integers and proper and improper fractions that have a variety and denominators, for example 8, 4 and 2.

- **Ordering fractions, decimals & percentages**
  Order integers, decimals to 1 decimal place, percentages and proper and improper fractions that have a variety of denominators.

- **Ordering including negatives**
  Order integers, decimals to 1 decimal place, percentages and proper and improper fractions that have a variety of denominators. Include ordering negative values.
All Prodigi Lessons

• Flower Power Lite
  ○ Ordering whole numbers & halves
    Order integers and mixed fractions that have a denominator of 2.
  ○ Ordering whole numbers, halves & quarters
    Order integers and mixed fractions that have a denominator of 2 or 4.
  ○ Ordering fractions & decimals
    Order integers, decimals of .25, .5, .75 and mixed fractions that have a denominator of 2 or 4.
  ○ Ordering harder fractions
    Order mixed fractions that have different denominators, for example 2, 5 and 10.
  ○ Ordering harder fractions & decimals
    Order decimals, mixed and improper fractions that have different denominators.

• Ice Ice Maybe
  ○ Estimate with addition & subtraction
    Calculate estimates using addition and subtraction.
  ○ Estimate with multiplication & division
    Calculate estimates using multiplication and division.
  ○ Estimate a percentage of a number
    Find estimates by calculating percentages of an amount.
  ○ Estimate a fraction of a number
    Find estimates by calculating fractions of an amount.

• Sigma Prime
  ○ Prime factorisation
    Decompose numbers using their prime factors.

• Sigma Prime Lite
  ○ Finding prime factors
    Decompose numbers using their prime factors.

• Arithmetic progressions
  ○ Recognise an arithmetic progression
    Recognise an arithmetic progression. Define and state the common difference and classify it as an increasing, decreasing, or constant progression.
  ○ Find terms in an arithmetic progression
    Find the common difference of an arithmetic progression by looking at consecutive terms.
  ○ Interpolate terms in an arithmetic progression
    Find the common difference of an arithmetic progression from non-consecutive terms.
  ○ The nth term of an arithmetic progression
Understand that the nth term of an arithmetic progression is $a + (n - 1)d$

- **Summing an arithmetic progression**
  To use the formulae $S_n = \frac{(a_1 + a_n)n}{2}$ and $S_n = \frac{(2a_1 + (n - 1)d)n}{2}$ to calculate the sum of the first $n$ terms of an arithmetic progression.

- **Simplifying algebra**
  - **Add and subtract terms with single letters**
    Simplify terms by collecting like terms that involve only 1 letter and constant terms. Include using number walls.
  - **Add and subtract terms with multiple letters**
    Simplify terms by collecting like terms that involve more than one letter e.g. $3ab + 4ba + 3a^2 + 4 + 2a^2 - 5$. Include using number walls.
  - **Multiply terms**
    Multiply terms together without brackets or simplify products in brackets to a positive integer power by considering repeated multiplication. e.g. $3a \times 4a$ or $(3a)^3$.
  - **Multiply a bracket by a number**
    Multiply across single brackets using a constant. Include negative examples and ones where the multiplier in not explicitly given because it is -1. Include examples where the bracket is added to or subtracted from a term and where the bracket has a term added or subtracted after it.
  - **Multiply a bracket by a term**
    Multiply across single brackets using a simple multiplier e.g. $3a$ or $-x$. (do not include a quadratic multiplier). Include examples that lead to indices in the solution. Include negative examples and ones where the multiplier in not explicitly given because it is -1. Include examples where the bracket is added to or subtracted from a term and where the bracket has a term added or subtracted after it.
  - **Expand sets of single brackets**
    Multiply across single brackets where more than one bracket is used. Simplify the resultant bracket multiplication. Restrict to examples to ones that do not include indices. Include negative examples and ones where the multiplier in not explicitly given because it is -1 or 1.
  - **Expand sets of single brackets with indices**
    Multiply across single brackets where more than one bracket is used. Simplify the resultant bracket multiplication. Include negative examples and ones where the multiplier in not explicitly given because it is -1 or 1. Include examples that lead to indices.
  - **Multiply two brackets together**
    Multiply with two brackets, both form $(x+a)$ or $(x-a)$, including adding and subtracting the results of bracket multiplication in order to simplify. Include squaring a linear bracket of form $(x+a)$ or $(x-a)$.
  - **Multiply two linear brackets together**
    Multiply with two brackets, both linear of form $(ax+b)$ or $(ax-b)$, including adding and subtracting the results of bracket multiplication in order to simplify. Also squaring a linear bracket of the form $(ax+b)$ or $(ax-b)$.
  - **Multiply any two brackets together**
    Multiply with two brackets, one or both non linear, including adding and subtracting the results of bracket multiplication in order to simplify. Include squaring a bracket.

- **Algebraic fractions**
  - **Simplify algebraic fractions**
    Cancel down an algebraic fraction by removing common factors. Use only simple factors that can be seen without the need to factorise.
Multiply and divide algebraic fractions
Multiply and divide fractions that include algebra and simplify by cancelling common factors without the need for factorising

Multiply and divide algebraic fractions using factorising
Multiply and divide fractions that include algebra and simplify by cancelling common factors after factorising

Add and subtract algebraic fractions
Add and subtract fractions in algebra to form a single fraction by making a common denominator. Use simple examples that do not require factorisation in order to fully simplify

Add and subtract algebraic fractions using factorising
Add and subtract fractions in algebra to form a single fraction by making a common denominator. Use examples that simplify by cancelling a factor found by factorising

• Factorising

Factorise using a common term
Remove a common factor to leave single brackets. Include more than one factor e.g. 7x² + 14x

Factorise using a common bracket
Remove common factors to leave double brackets e.g. (x+a)² - y(xx+a) = (x+a) (x+a-y)

Factorise quadratics in form x² + bx + c
Factorise quadratics of the form x² + bx + c including those that require manipulation to reduce to this form, including removing a common factor from each term first

Factorise quadratics in form ax² + bx + c
Factorise quadratics of the form ax² + bx + c including those that require manipulation to reduce to this form, including removing a common factor from each term first

Factorise x² - b² using the difference of two squares
Factorise quadratics and other expressions using the difference of two squares where the coefficient of x² is 1, or where a common factor can be removed to make it 1. e.g. 3x² - 3a²

Factorise a²x² - b² using the difference of two squares
Factorise quadratics and other expressions using the difference of two squares where the first term has a square coefficient other than 1. e.g. (ax)² - (by)² including removing a common factor from each term first

Factorise 4 terms into 2 brackets
Factorise 4 terms into 2 brackets, e.g. ax + ay - bx - by = (a-b)(x+y) , including removing a common factor from each term first

Quadratic factorising like (x + 2)(x + 3)
Factorise quadratic expressions of the form x²+bx+c where b and c are positive integers

Quadratic factorising like (x - 3)(x + 2)
Factorise quadratic expressions of the form x²+bx+c where b and c are integers

Quadratic factorising like (2x + 1)(x - 3)
Factorise quadratic expressions of the form ax²+bx+c where a, b and c are integers

Quadratic factorising like 2(3x - 1)(x + 2)
Factorise quadratic expressions of the form ax²+bx+c where a, b and c are integers and remove a factor common to each term
• Forming algebra
  ○ Form an expression or formula
    Form an expression or find a formula and express using algebraic notation (but use words at easier levels) including brackets in one or two operations. Include using a given relationship to form a new one, e.g. \( y = 2x \), find \( 2y + 1 \) in terms of \( x \)
  ○ Form an equation
    Form a linear equation. Use the equation to find a further result or prove a result you are asked to show is true, by rearranging and/or solving. Use negative terms appearing anywhere. Brackets may or may not be used. Include graphs that model a linear real-life situation, e.g. delivery charge based on distance travelled
  ○ Form equations with indices
    Form a non linear equation. Use the equation to find a further result or prove a result you are asked to show is true, by rearranging and/or solving. Include real-life situations that are modelled by a non-linear equation. Use simple examples
  ○ Form complex equations with indices
    Form a non linear equation. Use the equation to find a further result or prove a result you are asked to show is true, by rearranging and/or solving. Include real-life situations that are modelled by a non-linear equation. Use complex examples
  ○ Equations, formulae, functions, expressions & identities
    Understand the difference between equations, formulae, functions, expressions and identities
  ○ Use identities to solve problems
    Compare coefficients, particularly with expanded and completed square form. Other forms are also possible. The completed square need not be used, but would be a more efficient method

• Substituting values
  ○ Substitute whole numbers into algebra
    Without a calculator, putting numbers into expressions, formulae and equations, including tables of values. Use only 1 or 2 operations. Use only linear examples. Only substitute positive integers
  ○ Substitute whole numbers into algebra using indices
    Without a calculator, putting positive and negative integers into expressions/functions/equations and formulae including common mathematical and non-maths formulae, including tables of values. Linear and non linear examples. Restrict to positive integers when raising an integer to a power. Only raise to positive integer powers
  ○ Substitute positives & negatives into algebra using indices
    Without a calculator, putting positive and negative integers into expressions/functions/equations and formulae including common mathematical and non-maths formulae, including tables of values. Linear and non linear examples. Include raising a negative integer to a positive integer power
  ○ Substitute any number into algebra
    Without a calculator, putting any number (i.e. fractions, decimals, negatives) into linear and non-linear expressions, formulae/functions and equations including common mathematical and non-maths formulae, including tables of values. Only use positive integer powers
  ○ Derive results using algebraic substitution
    Without a calculator, putting any number (i.e. fractions, decimals, negatives) into linear and non-linear expressions, formulae/functions and equations including common mathematical and non-maths formulae, including tables of values, also examples of the type:- derive the value of \( a^2 + 2ab + b^2 \) from \((a+b)^2\) by substituting suitable values of \( a \) and \( b \), e.g. given \((a+b)^2 = a^2 + 2ab + b^2\) substitute values of \( a \) and \( b \) to find the value of \( 17^2 + 102 + 3^2 \). Include negative integer powers
  ○ Number machines
    Use 1 and 2 stage number / function machines. Express the results of a function in a mapping diagram
• **Solving linear equations**
  
  - **Introducing equations**
    Solve a linear equation by performing a single stage, either add, subtract, multiply or divide. Use integer coefficients or integer division. Unknown on one side
  
  - **Solve linear equations**
    Apply combinations of add, subtract, multiply and divide to solve linear equations. Limit to unknowns on one side and integer coefficients or division by an integer. Include examples of addition and subtraction with negatives. Do not include multiplication and division with negatives
  
  - **Solve linear equations involving negatives**
    Solve linear equations that include a negative term appearing anywhere. These should include the unknown term appearing on one or both sides, with or without brackets. Restrict to integer coefficients or division by an integer. Include examples that involve addition, subtraction, multiplication and division with negatives
  
  - **Solve linear equations involving brackets**
    Solve linear equations that include bracketed terms. Limit to integer coefficients, or division by an integer. Do not include negative algebraic terms. Include examples that involve addition, subtraction, multiplication and division with negatives. Limit to letters on one side only
  
  - **Solve linear equations with an unknown on both sides**
    Solve linear equations that include terms on both sides of the equation. Limit to integers or division by an integer. Include examples that involve addition, subtraction, multiplication and division with negatives. Include bracketed terms. Do not include negative algebraic terms
  
  - **Solve linear equations involving fractions and decimals**
    Solve linear equations that involve more than one fraction or an algebraic term in the denominator. Include any type of coefficient including decimals and mixed fractions. Include negatives appearing anywhere in the equation

• **Solving quadratics (factorising)**
  
  - **Solve quadratics with 2 terms**
    Solve by first factorising in one bracket, form \( ax^2 + bx = 0 \)
  
  - **Solve quadratics by factorising - coefficient of \( x^2 \) equals 1**
    Solve by first factorising into 2 brackets including equations that require a common factor to be removed first, form \( x^2 + bx + c = 0 \) or \( px^2 + px + pc = 0 \)
  
  - **Solve quadratics by factorising - coefficient of \( x^2 \) more than 1**
    Solve by first factorising into 2 brackets where the equations are of the form \( ax^2 + bx + c = 0 \) where \( a, b, c \) are all integers and 'a' is not 1 and 'b' is not zero. Include equations that require a common factor to be removed first but that do not leave a coefficient of 1 for the \( x^2 \) term. Include using the difference of two squares where the coefficient of \( x^2 \) is not 1

• **Solve quadratics using the formula**
  
  - **Solve quadratics by using the quadratic formula**
    Use the quadratic formula to find rounded or exact solutions

• **Completing the square**
  
  - **Completing the square**
Write in the form \((x+a)^2+b\) including those with non integer ‘a’ and ‘b’

- **Completing the square - coefficient of \(x^2\) more than 1**
  Write in the form \(a(x+b)^2+c\) including those with non integer ‘b’ and ‘c’, note that ‘a’ could be negative

- **Use the completed square**
  Find the maximum or minimum value of a quadratic expression using the completed square and find the ‘\(x\)’ value that is required. Also, solve a quadratic by first completing the square and then making ‘\(x\)’ the subject

### Solve equations by rearranging

- **Solve equations by rearranging**
  Solve equations of the form \(ax^2+b = c\), \(ax^3+b = c\) and other equations involving a single power or root by making ‘\(x\)’ the subject (non calculator and calculator examples). The term only appears once. Does not include completed square examples

### Inequalities

- **Inequalities**
  Solve one sided linear inequalities in 1 variable and find max/min integer solution or a list of integer solutions from a set

- **Two inequality signs**
  Solve two sided linear inequalities and list integer solutions

- **Inequalities on a number line**
  Represent the solutions of an inequality in one variable on a number line

- **Inequalities on graphs**
  Solve inequalities in two variables and represent on a coordinate grid. List integer solutions within a specified region (some maybe on the boundary, some not). Both solid and dashed lines could be used

### Simultaneous equations

- **Solve simultaneous equations - straight line graphs**
  Solve two linear simultaneous equations by drawing the lines, including examples of parallel and co-linear lines. Include examples that model real situations.

- **Solve simultaneous equations - elimination method**
  Use the elimination method to solve a pair of linear simultaneous equations

- **Solve simultaneous equations - substitution method**
  Solve one linear and one quadratic by algebraic substitution. The quadratic equation may be quadratic in one or more terms

- **Solve simultaneous equations - curved graphs**
  Solve one linear and one quadratic led in graphically, recognise that the intersection represents the solution of the simultaneous equations, solve graphically or by algebraic substitution, especially a line and circle. The quadratic equation may be quadratic in one or more terms

- **Forming simultaneous equations**
  Australian teaching objective

### Rearranging formulae
- **Rearrange formulae**
  Rearrange a formula where the term appears only once, linearly with a possible combination of the 4 rules and brackets or where the term to be made the subject appears more than once but with given numerical coefficients.

- **Rearrange formulae with indices**
  Rearrange a formula where the term appears only once raised to a power or root with a possible combination of the 4 rules and brackets.

- **Rearrange formulae where the subject appears more than once**
  Rearrange a formula where the term appears more than once and requires the use of factorising, with a possible combination of the 4 rules and brackets.

- **Trial and improvement**
  - **Trial and improvement**
    Trial and improvement including checking the mid-interval of 1dp or 2dp, most commonly non quadratic e.g. cubic, square root, cube root. Could also be asked for the solution or root.

- **Coordinates**
  - **Coordinates**
    Plot and read points in the first quadrant in 2D. Include different scales on the axes and awkward scales to interpolate. Find coordinates given geometric information e.g. the three vertices of a square are given and the fourth is asked for.
  - **Coordinates in 4 quadrants**
    Plot and read points in all 4 quadrants in 2D. Include different scales on the axes and awkward scales to interpolate. Find coordinates given geometric information e.g. the three vertices of a square are given and the fourth is asked for.
  - **Midpoints**
    Australian teaching objective

- **Straight line graphs**
  - **Recognise common straight line graphs**
    Draw and recognise lines $y = a$, $x = a$, $y = x$, $y = -x$, $y = x+a$, $y = -x+a$, $x+y = a$ without the need to construct tables of values.
  - **Draw straight line graphs**
    Plot graphs of explicit linear functions given in form $y = mx+c$ using a table of values and understand that points satisfying the equation lie on the line. Use only a simple linear rule e.g. $y = 2x+1$ not $y = -0.5x+3$.
  - **Draw straight line graphs using $y = mx + c$**
    Plot graphs of explicit linear functions given in form $y = mx+c$ using a table of values and understand that points satisfying the equation lie on the line. Use more difficult linear rules e.g. $y = -0.5x-3$. Include simple implicit functions like $x+y = a$.
  - **Draw straight lines using implicit equations**
    Plot graphs of implicit linear functions given in form $ay=bx+c$ OR $ax+by=c$ OR $ax+by+c=d$ (or more complex equation that reduces to these forms) using a table of values and understand that points satisfying the equation lie on the line.
  - **Test to see if a point is on a line**
    Prove a point lies on a line when given the equation.
All Prodigi Lessons

- Find the gradient of a line using its graph
  Find the gradient of a line using 2 points it passes through with reference to a graph, grid or sketch. The graph may need to be drawn first from the equation that may be expressed implicitly or explicitly.

- Find the gradient of a line using its equation
  Find the gradient of a line when given 2 points it passes through without reference to a graph. The general formula for the gradient could be used.

- Find the equation of a line from a graph
  Know the formula \( y=mx+c \) and understand that \( m \)=gradient and \( c \)=y-intercept. Find the equation of a line when the graph is given by finding ‘\( m \)’ and ‘\( c \)’ from the graph.

- Find the equation of a line given the gradient and a point
  Find the equation of a line when the gradient and any point (not the y-intercept) is given without reference to the graph. Substitute the point into the formula \( y=mx+c \) to find \( c \) OR find the equation of a line when two points are given, one being the y-intercept without reference to the graph by using the formula \( y=mx+c \) and finding the gradient from the 2 points.

- Use patterns in coordinates to find the equation of a line
  Spot the equation of a line from looking at the pattern in the coordinates, simple examples e.g. \( x+y=5 \) or \( y=x+3 \)
  OR find the equation of a line described by a rule e.g. points are equidistant from the X and Y axes OR x coordinates are half of the y coordinates.

- Find the x and y intercepts of lines
  Find the x and y intercept when given the equation of a line in any form (with or without a sketch).

- Find the gradient and y intercept from the equation of a line
  When given an equation of a straight line find the gradient and y-intercept by rearranging the equation if necessary to the form \( y=mx+c \).

- Match together equations and lines
  Recognise \( y=mx+c \) and \( ax+by=c \) (or equivalent formulae) give a straight line and recognise a sketch of them (by rearrangement into the form \( y=mx+c \)) in the absence of a scale on the axes.

- Equations of parallel lines
  Recognise that lines are parallel if they have equal gradients and state an equation of a line parallel to the given graph/equation passing through a given y-intercept. Identify parallel lines from only their equations by rearranging them in the form \( y=mx+c \).

- Equations of perpendicular lines
  Know that perpendicular gradients are the negative reciprocals of each other and give the equation of a perpendicular line when provided with either a given graph or equation in the form \( y=mx+c \). (do not need \( m_1 \times m_2 = -1 \)). Identify perpendicular lines from only their equations by rearranging them in the form \( y=mx+c \).

- Real life straight line graphs
  Plot points for real life problems that lead to a linear function and interpret the meaning of real life problems modelled as linear functions. Include simple examples like conversion graphs.

- Curves
  - Recognise the equations of common curves
    Recognise and know the sketches of quadratics, cubics and reciprocals, including the shape of positive and negative functions and interpretation of their y-intercepts. Also match sketches of curves to their equations.

  - Drawing quadratic curves
    Draw graphs of simple quadratic equations with or without the prompt of a table of values, e.g. \( x^2 \), \( 3x^2+4 \), \( x^2-4x-2 \).

  - Drawing curves
    Draw graphs of harder quadratic and harder cubic functions. Also exponential \( y=kx \) for simple positive k and
integer x) and reciprocal equations with or without the prompt of a table of values. Understand that a quadratic is smooth and symmetrical. Find the equation of the line of symmetry on a quadratic using the vertex on the graph, also find the line of symmetry using the mid point of the 2 roots with the graph and without the graph

- **Test to see if a point is on a curve**
  Test prove/disprove that a point lies on a curve when given the equation

- **Find the equation of a curve**
  Spot the equation of a curve from looking at the pattern in the coordinates, e.g. \( y = x^2 + 1 \) OR find the equation of a curve described by a rule e.g. the product of the coordinates is always 5.

- **Find the x and y intercepts of curves**
  Find x and y intercepts of a non linear function given the graph and/or function. Understand that no solution of an equation equal to zero, means no intercept

- **Exponential graphs**
  Recognise and know the sketches of exponentials of the form \( y = kx \) for simple positive k and integer x. Including the shape of positive and negative functions and interpretation of their y-intercepts. Also match sketches of curves to their equations. Also, find the equation of an exponential function given its form and the coordinates it passes through, then use it to find other points

- **Trigonometric graphs**
  Draw graphs of sin, cos, tan and graphs based on these functions and understand periodicity and symmetry and how the values of the trig functions change as x changes. Draw the graphs both from memory and using a table of values to tabulate the coordinates

- **Circle equations**
  Recognise and draw the circle equation \( x^2 + y^2 = a^2 \) and know its centre and radius from the equation. Include completing a table of values for coordinates on the circumference

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**Solving equations using graphs**

- **Use graphs to solve equations**
  Find the roots or solve \( f(x) = 0 \) as an alternative way of asking for a solution to the quadratic equal to zero. Solve quadratics of type e.g. \( x^2 + 2x + 2 = 4 \) after having drawn \( y = x^2 + 2x + 2 \) or \( y = x^2 + 2x + 1 \) or \( y = x^2 + x - 3 \) by drawing a linear graph or reading off points. Also solve cubics, reciprocals and exponentials equations with the aid of graphs

- **Use graphs to solve trigonometric equations**
  Look at problems that involve angles of any size and solve trig equations with the aid of graphs, may or may not be drawn already in the exam

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**Graphical transformations**

- **Translate graphs vertically**
  Apply \( f(x) + a \) to linear, quadratic, trig, step and other types of functions both graphically and algebraically. Include the use of the \( f(x) \) notation

- **Translate graphs horizontally**
  Apply \( f(x + a) \) to linear, quadratic, trig, step and other types of functions both graphically and algebraically. Include the use of the \( f(x) \) notation

- **Reflect graphs**
  Apply \( f(-x) \), \(-f(x)\) to linear, quadratic, trig, step and other types of functions both graphically and algebraically. Include the use of the \( f(x) \) notation

- **Stretch graphs in the y direction**
Apply af(x) to linear, quadratic, trig, step and other types of functions both graphically and algebraically. Include the use of the f(x) notation

- **Stretch graphs in the x direction**
  Apply f(ax) to linear, quadratic, trig, step and other types of functions both graphically and algebraically. Include the use of the f(x) notation

**Sequences**

- **The term to term rule**
  Find a term to term rule and express it in words. This may come from a sequence of numbers or pictures. Include sequences where the rule is linear and non linear e.g. +6 each time or multiply each term by 2 or add 2,4,8,16 to each term. Find the next term or subsequent terms in a sequence spotting the term to term rule. Include diagrams in isolation. Generate a sequence following a term to term rule expressed in words. Use an iteration where the explanation of the method is explicitly given. Do not use T(n) and T(n+1) notation

- **Find the nth term of a linear sequence**
  Find a linear nth term and express it in words and algebraically. The terms arithmetic sequence and linear sequence should be understood

- **Find the nth term of a non-linear sequence**
  Find a quadratic nth term in words or express algebraically. Find other simple non linear nth term rules in words or express algebraically. e.g. n/(n+1)

- **Use nth term to generate linear sequences**
  Find particular terms using the nth term rule (linear) or find other terms in a linear sequence using the first term i.e. a + (n-1)d. Generate a sequence using position to term rules including using the formula for nth term (linear)

- **Use nth term to generate sequences**
  Find particular terms using the nth term rule (non-linear). Generate a sequence using position to term rules including using the formula for nth term (non-linear)

- **Use the nth term to solve problems**
  Work an nth term backwards to prove / disprove that a term is part of a sequence. Include examples where the nth term need not be found and other considerations can be used, e.g. All terms are even

- **Patterns and linear rules**
  Relate the nth term to a practical problem or pattern through a diagram. Describe in words or write algebraically the nth term for linear patterns only

- **Patterns and non-linear rules**
  Relate the nth term to a practical problem or pattern through a diagram. Describe in words or write algebraically the nth term for non-linear patterns including quadratics

**Sketch graphs**

- **Sketch graphs - filling containers**
  Draw sketches of graphs for depth or volume against time for different shaped containers filled at constant rates

**Proportionality equations**

- **Direct proportion**
  Form and use the formula for direct proportion/variation, include power and root relationships, generally not higher than cube or cube root
• Using algebra
  ◦ Explain relationships between numbers
    Recognise, represent and interpret simple number relationships, constructing and using formulae in words [for example, 15 times n is the cost, in pence, of n articles at 15p each]
  ◦ Use < > and =
    Use correctly the symbols <, >, =. Include four digit numbers and negative numbers

• Algebra and sequences
  ◦ Recognise number patterns and relationships
    Explore patterns, properties and relationships involving numbers. Recognise and describe number patterns, including two- and three-digit multiples of 2, 5 or 10, recognising their patterns and using these to make predictions, including odds and evens. Also prime and square numbers, other times tables (e.g. 19, 26, 33. Would 77 be in this sequence? Can you explain why?)
  ◦ Test a general statement using numbers
    Propose a general statement involving numbers; identify examples for which the statement is true or false

• Algebra Meltdown
  ◦ Introducing equations and function machines
    Use the four operations with positive and negative integers to solve problems involving 1- and 2-stage function machines and linear equations.
  ◦ Two-step equations, including brackets
    Use the four operations with positive and negative integers to solve problems involving 1- and 2-stage function machines and linear equations that include brackets and terms on both sides.
  ◦ Harder two-step equations
    Use the four operations with positive and negative integers to solve problems involving 1- and 2-stage function machines and linear equations that include brackets. Also, use algebraic substitution to find possible solutions to identities.
  ◦ Three-step equations
    Use the four operations with positive and negative integers to solve problems involving 1-, 2- and 3-stage function machines and linear equations that include brackets and terms on both sides. Also, use algebraic substitution to find possible solutions to identities.

• Save Our Dumb Planet
  ◦ Graphs of linear equations
    Find the equation of a linear graph that passes through two points. Plot points that correspond to a linear function.
  ◦ Graphs of quadratic equations
    Find the equation of a quadratic graph that passes through a set of points. Plot points that correspond to a quadratic function.
  ◦ Graphs of linear, quadratic & cubic equations
    Find the equations of cubic, quadratic and linear graphs that pass through sets of points. Plot points that correspond to these functions.
All Prodigy Lessons

- **Exponential functions**
  - Define exponential functions
    Recognise what an exponential function looks like as an equation. Understand how they can be used for simple examples.
  - Graphs and types of exponential functions
    Be able to recognize if an exponential function is increasing or decreasing by looking at the graph or the equation. Know the difference between an increasing and decreasing function.
  - Solve exponential equations
    Solve equations like $2^x = 2^{3x + 4}$ by comparing the indices. Recognise that solving $x = 3x + 4$ gives you the solution.
  - Solve exponential inequalities
    Apply the exponential function properties when solving algebraic inequalities, e.g. Solve $2^x$
  - Solving problems using exponentials
    Apply the concept of exponential function when solving problems. Include problems that involve things like doubling a quantity each day or interest rates.

- **Log functions**
  - Calculating logarithms
    Calculate the value of a logarithm and change between log and index form. e.g. work out the value of log to the base 2 of 8
  - Adding and subtracting logarithms
    Add and subtract logarithms of the same base by using the laws of logs. e.g. $\log_{3}5 + \log_{3}7$
  - Logarithms of powers
    Simply and evaluate logarithms that involve indices. e.g. $\log_{2}4$ to the power of 8
  - Changing the base of logarithms
    Change the base of logarithms and evaluate logarithms. e.g. $\log_{5}3 + \log_{81}5$ can be written as $k\log_{3}5$. Evaluate $k$
  - Solving problems using logarithms
    Solve algebraic and real world problems that arise from logarithms. e.g. $\log_{2}(\frac{N}{10}) = x$ models the number of lilies $(N)$ on a pond after $(x)$ days. Find $x$ if $N = 80$

- **Angles**
  - Types of angle
    Use three points to name an angle and define its two arms. Know what is meant by acute, obtuse and reflex and recognise them without measurement
  - Basic angle rules
    Use angles at a right angle and use perpendicular lines. Spot right angles of any orientation on a square grid. Understand the term complementary angles. Also use the rule that angles on a straight line at a specific point sum to 180. Solve problems involving straight line angles. Understand the term supplementary angles. Also use the rule that angles at a point sum to 360. Known as a full turn.
  - Opposite angles
    Recognise and calculate with vertically opposite angles. The term 'opposite' will be acceptable
- **Corresponding angles**
  Understand that when parallel lines are crossed by another line, corresponding angles are created. Solve problems involving the corresponding angles. The term "F" angle is not sufficient to explain why 2 angles are equal.

- **Alternate angles**
  Understand that when parallel lines are crossed by another line, (interior) alternate angles are created. Solve problems involving the alternate angles including understanding the properties of allied angles, although this term is not examined. The term "Z" angle is not a sufficient reason for two angles being equal.

- **Measuring angles**
  Use an angle measurer (protractor) to measure angles accurately and to draw angles of any size accurately.

- **Bears**
  Measure and draw three figure bearings including practical problems involving two bearings to locate a specific point. Include examples where the alternate and corresponding angle are required between 2 north lines.

- **Triangles**
  - **The angles inside a triangle**
    Know that the sum of the interior angles of a triangle is 180 and use this result to solve problems. Does not include knowledge of the different triangle properties.

  - **Types of triangle**
    Recognise equilateral, isosceles, scalene and right-angled triangles and know their properties and angle rules and use them to solve problems involving angles and sides. Classify them further using acute angled, right angled and obtuse angled triangles. Know the term perpendicular height. Use the written word to describe reasoning when solving problems.

  - **Proof of the sum of the angles in a triangle**
    Understand a proof of the sum of the angles in a triangle is 180 degrees.

  - **Proof of the exterior angle rule for a triangle**
    Understand a proof that any exterior angle of a triangle is equal to the sum of the two interior angles at the other two vertices.

- **Quadrilaterals**
  - **The angles inside a quadrilateral**
    Know that the sum of the interior angles of a quadrilateral is 360 and use this result to solve problems.

  - **Recognise a square and rectangle**
    Recognise a square and rectangle.

  - **Recognise quadrilaterals**
    Recognise a rhombus, parallelogram, kite, trapezium, isosceles trapezium, arrowhead (aka inverted kite), re-entrant (aka concave quadrilateral).

  - **Facts about quadrilaterals**
    Know and use the angle, length and diagonal properties of a square, rectangle, rhombus, parallelogram, trapezium, isosceles trapezium, kite, arrowhead (aka inverted kite), reentrant (aka concave quadrilateral). Classify quadrilaterals by their properties. Use the written word to describe reasoning when solving problems.

- **Polygons**
  - **Recognise regular polygons**
Understand the term polygon and regular polygon. Identify regular and non regular pentagons, hexagons and octagons, know the name of the polygons

- **Exterior angles of polygons**
  Know the sum of exterior angles is 360. Solve problems with the exterior angle including finding the number of sides of a regular polygon using the exterior angle

- **Interior angles of polygons**
  Calculate the sum of the interior angles in a polygon by subdividing it into triangles. Understand the relationship between an interior and exterior angle at the same vertex. Solve problems involving the interior angle including the number of sides in a regular polygon. Discover if polygons tessellate by examining their interior angles

- **Tessellations**
  Tessellate by drawing further shapes joined together. Include drawings on isometric paper

### Congruence

- **Recognise congruent shapes**
  Know the definition of congruence and say if 2 shapes are congruent, simple shapes only

- **Congruency**
  Spot congruent shapes among a group of shapes without calculation, just by visual inspection. Spot congruent triangles using 2 equal angles and one length between the same two angles or 3 equal sides

- **Congruent triangles**
  Use formal proof that two triangles are congruent, using the following language: SSS, SAS, ASA, SAA, RHS as congruent and ASS and AAA as not necessarily congruent. Use diagrams that have the triangles imbedded where geometric reasoning must be used to determine the relationship between sides and angles. e.g. prove that the triangles formed by drawing in one diagonal of a parallelogram are congruent. Include examples that make use of the perpendicularity of the tangent and radius of a circle

### 3D shapes

- **Recognise a cube and cuboid**
  Recognise a cube and cuboid and know their basic properties in terms of faces, edges, vertices and cross section. Explore the geometry of shapes made from cuboids

- **Recognise a prism**
  Recognise a prism and know its basic properties in terms of faces, edges, vertices and cross section. Understand types of prism, e.g. triangular, pentagonal

- **Recognise a pyramid**
  Recognise a pyramid and know its basic properties in terms of faces, edges, vertices and cross section. Understand types of pyramid, e.g. triangular based (tetrahedron), square based, pentagonal based

- **Recognise a cylinder, sphere and cone**
  Recognise a sphere, cylinder and cone. Know their basic properties in terms of faces, edges, vertices and cross section

- **Nets**
  Draw and recognise nets of 3D shapes. Prove or disprove that a net will form a particular solid. Use ruler and protractor to construct nets accurately or draw them on a square grid e.g. Tetrahedron and square based pyramid

- **Isometric drawings**
  Draw 3D shapes on either orientation of isometric paper
**Elevated drawings**

Draw 3D shapes given the plan, front, back, side elevations/views and cross sections. Draw the elevations/views given the name of the 3D shape or a picture. Draw missing elevations given the other views. Use simple plans/views and elevations as well as a mixture of depths shown as a line across the elevation.

**Length, area and volume**

- **Perimeter**
  Understand that the perimeter means the total distance around a shape. Calculate the perimeter of polygons based on rectangles and triangles.

- **Area by counting squares**
  Understand that the area means the number of squares (or possibly other congruent shapes) of a specific size inside a shape. Count squares or parts of squares to find the area, either exactly or as an estimate. Include writing the units of the area.

- **Area of a rectangle**
  Find the area of a rectangle by multiplying the sides. Understand that this is working out the number of squares inside the rectangle. Include the units of area. Include compound shapes made from rectangles.

- **Area of quadrilaterals**
  Calculate the area of a rhombus, parallelogram, trapezium and kite by knowing the formula and applying it. Also be able to derive these formulae. The trapezium formula would be given to a student in a public exam. Include reverse problems e.g. find the perimeter or a side given the area.

- **Area of a triangle**
  Calculate the area of a triangle using the base length multiplied by the perpendicular height, then divided by 2. Include reverse problems e.g. find the perimeter or some side given the area. Derive the formula by considering the rectangle being halved.

- **Area of a triangle using trigonometry**
  Calculate the area of any triangle using the formula \( \frac{1}{2} ab \sin C \). Students would not be expected to remember this formula in a public exam. Include reverse problems e.g. find the perimeter or some side given the area.

- **Area of joined shapes**
  Calculate the areas of shapes made from triangles and quadrilaterals. Include reverse problems e.g. find length given area.

- **Surface area of cubes and cuboids**
  Calculate the surface area of a cube or cuboid.

- **Surface area of joined shapes**
  Calculate the surface area of objects made from cubes and cuboids as well as objects with faces formed by triangles and quadrilaterals, including prisms. Include reverse problems e.g. find the edge lengths given the surface area.

- **Surface area of a sphere**
  Calculate using the surface area for a sphere (formula given) and hemisphere to solve problems. Include reverse problems using the value of the surface area. Include leaving answers in terms of \( \pi \) or as approximations \( \pi \approx 3 \).

- **Surface area of a cone**
  Use the curved surface area of a cone (formula given) or the total surface area. Include reverse problems by using the given value of the surface area. Include the use of Pythagoras to relate the slanted height to the perpendicular height and radius. Include leaving answers in terms of \( \pi \) or as approximations \( \pi \approx 3 \).

- **Surface area of a pyramid**
  Calculate the surface area for a pyramid, simple cases only. Include reverse problems.

- **Volume by counting cubes**
Understand that volume means the number of cubes of a specific size. Count cubes or parts of cubes to find the volume, either exactly or as an estimate

- **Volume of a cuboid**
  Calculate the volume of a cube and cuboid, by understanding why the dimensions are multiplied and by knowing the formula and applying it. Calculate the volume of shapes made from cubes and cuboids

- **Volume and problem solving**
  Calculate with the volume of a cube and cuboid. Solve reverse problems e.g. find the edge lengths or surface area given the volume

- **Volume of a prism**
  Calculate the volume of a prism. The formula is given in public exams. Include reverse problems e.g. find the edge lengths or cross sectional area given the volume. Most commonly triangular prisms or prisms where the cross sectional area is given

- **Volume of spheres**
  Calculate with the volume of a sphere. Use the correct formulae. e.g. A sphere has a radius of 5 cm, what is its volume?

- **Volume of cones**
  Calculate with the volume of a cone. Use the correct formulae. e.g. Find the volume of a right cone of radius 4 cm and perpendicular height 7 cm

- **Volume of pyramids**
  Calculate with the volume of a pyramids. Use the correct formulae. e.g. Find the volume of a pyramid with base area 9 square cm and height 6 cm

- **Volume of frustum of a cone**
  Calculate with the volume of a frustum of a cone. e.g. Calculate the volume of a frustum of a cone if it is cut from a cone with a base width of 16cm and a perpendicular height is 6 cm. The cone is cut horizontally half way up its height.

- **Dimensions in formulae**
  Identify a formula as representing a length, area or volume by consideration of the way in which the length measurements are combined. Identify formula that do not represent length, area or volume

- **Circles and cylinders**
  - **The parts of a circle**
    Understand the terms radius, diameter, chord, circumference, arc, sector, segment, tangent
  - **Circumference of a circle**
    Find the circumference of a circle or simple arc lengths and perimeters, e.g. perimeter of a semi-circle. Include simple compound shapes, e.g. a rectangle and two semi-circles. Include approximations (?=3), use pi button and answers in terms of ?
  - **Area of a circle**
    Find the area of a circle or simple fraction of a circle, e.g. area of a semi-circle. Include simple compound shapes, e.g. a rectangle and two semi-circles. Include approximations (?3). Include approximations ?3), use pi button and answers in terms of pi
  - **Find the radius from the circumference of a circle**
    Calculate measurements on a circle given the circumference. Either rearrange the formulae or substitute values into the formulae and solve. Include leaving answers in terms of ? or as approximations (?=3) or use the pi button
  - **Find the radius from the area of a circle**
    Calculate measurements on a circle given the area. Either rearrange the formulae or substitute values into the formulae and solve. Include leaving answers in terms of ? or as approximations (?=3) or use the ? button
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- **Arc length**
  Solve problems with arcs. Use the formula for the length of an arc for any angle. Include reverse problems e.g. find the sector angle given the other measurements. Include leaving answers in terms of pi or as approximations (?) or use the pi button.

- **Sector area**
  Solve problems with sectors. Use the formula for sector area for any angle. Include reverse problems e.g. find the sector angle given the other measurements. Include leaving answers in terms of pi or as approximations (?) or use the pi button.

- **Segment area**
  Use the formula for sector area for any angle and the formula for the area of any triangle to find the segment area (formula for area of any triangle is given in public exams). Include reverse problems e.g. find the sector angle given the other measurements. Include leaving answers in terms of pi or as approximations (?) or use the pi button.

- **Surface area of a cylinder**
  Find the curved or total surface area of a cylinder. Include reverse problems. Include leaving answers in terms of pi or as approximations (?) or use the pi button.

- **Volume of a cylinder**
  Find the volume of a cylinder. Also find other measures on a cylinder when given the volume i.e. reverse problems. Include leaving answers in terms of pi or as approximations (?) or use the pi button.

- **Circle theorems**
  - **Radius and chord rule for circles**
    Understand that if a radius bisects a chord, then it does so perpendicularly (and visa versa). Explain why the radius bisects the chord if the radius and chord are perpendicular (can be done by Pythagoras to show the 3rd length in each triangle is equal and therefore the chord is bisected) or by congruent triangles using RHS rule.
  - **Isosceles triangles inside circles**
    Spot isosceles triangles in a circle made from 2 radii and a chord. Use the properties of isosceles triangles to solve problems.
  - **Right angle in a semi-circle rule**
    Use the theorem that the triangle in a semi-circle is right angled.
  - **Cyclic quadrilateral rule for circles**
    Use the theorem that opposite angles in a cyclic quadrilateral sum to 180 and understand why some quadrilaterals cannot be inscribed inside a circle. Identify cyclic quadrilaterals in isolation i.e. without reference to circles.
  - **Angle at the centre and angle at the edge rule for circles**
    Use the theorem that the angle at the centre is twice the angle on the major arc.
  - **Angles at the edge rule for circles**
    Use the theorem that angles in the same segment are equal at the circumference (also known as:- angles standing on the same chord).
  - **Radius and tangent rule for circles**
    Use the theorem that the tangent is perpendicular to the radius at point of contact. Know that two tangents drawn from a point outside a circle are equal in length. Solve problems involving this theorem especially those that form isosceles/congruent triangles and right angled kites.
  - **Alternate segment theorem rule for circles**
    Use the alternate segment theorem.
Similar shapes

- **Recognise similar shapes**
  Understand what is meant by similar and identify simple similar shapes. Understand that all regular shapes are similar e.g. Squares and circles. But that in general rectangles are not.

- **Solve problems with similar shapes**
  Identify similar triangles and solve problems by matching corresponding sides/angles in order to find the scale factor. Also determine if two shapes are similar by comparing the scale factors of corresponding sides.
  Understand that all regular shapes are similar, but other shapes are generally not similar.

- **Length, area and volume scale factors**
  Solve problems involving the link between length, area and volume scale factors. e.g. compare corresponding areas to find the area scale factor and hence find the volume scale factor and the corresponding volume of one of the shapes.

Locus and construction

- **Construct triangles**
  Construct triangles of type SAS, ASA and AAS, accurately using ruler/protractor. When constructing AAS, find the missing angle first using the angle sum of a triangle. Also construct triangles of type SSS accurately using ‘ruler/compass’. Include the construction of an equilateral triangle.

- **Construct bisectors and other lines**
  Using a ruler and compass only construct the perpendicular bisector of a line AB, or the midpoint and understand that the locus gives you all the points equidistant from the points A and B. Also construct the perpendicular to a line through either a point on the line or a point off the line. Also construct the bisector of an angle AOB and understand that the locus gives you all the points equidistant from the lines OA and OB.

- **Locus problems**
  Construct the locus of points subject to a set of rules. These can include using a perpendicular bisector, angle bisector, parallel lines, arcs or circles. Construct the path of a point moving from a fixed centre. Understand that the shortest distance between a point and a line is found perpendicularly.

- **Boundaries around shapes**
  Draw a boundary around a shape keeping a constant distance from the edge of the shape. Include shapes that require parallel and perpendicular lines as well as arcs. Also include problems involving circles i.e. a fixed distance from a point e.g. trees in a garden can’t have other trees planted within a certain distance.

Units of measurement

- **Metric units**
  Use and change between Metric units:- know mg, g, kg, tonnes, mm, cm, m, km, ml, cl, litres. Use and change between metric units of capacity and volume (i.e. cubic cm and ml). Know when certain measures are appropriate.

- **Changing between metric and imperial units**
  Use and change between Metric / Imperial units:- know 1 inch = 2.5 cm, 1 foot = 30 cm, 3/4 feet = 1 metre, 5 miles = 8 km, 2/4 lb = 1 kg, 11/4 pints = 1 litre, 1 gallons = 4.5 litres.

- **Units of area and volume**
  Covert between Metric area (e.g. cm² to m²) and metric volume (e.g. cm³ to m³).

- **Reading scales**
  Read simple scales that measure mass, time, length etc. Include using a ruler to measure within 1mm. Include understanding what each division is representing.
Measuring
Choose an appropriate unit to measure a certain quantity and the instrument necessary for the measurement. Also estimate measurements of everyday objects, especially mass.

Maximum and minimum values of measurements
Understand the difference between discrete and continuous types of measure (knowledge of the terms discrete and continuous is not needed). Understand that you can add and subtract one half of the accuracy for continuous measures. The amounts that have been rounded are given to the nearest integer or another positive power of ten, not given as decimals. Understand that discrete maximum values are always one less than half the accuracy added on.

Symmetry

Rotational symmetry
State the order of rotational symmetry for a shape and know the order for all the common 2D shapes including regular polygons. Complete the drawing of a shape to give it a certain order of rotational symmetry. Other properties of 2D shapes need not be known.

Lines of symmetry
Identify the lines of symmetry (also know as reflection or axes symmetry) for a shape and know the position of the lines of symmetry for all the common 2D shapes including regular polygons. Complete the drawing of a shape to give it certain lines of symmetry.

Planes of symmetry
Identify the planes of symmetry for a shape. Complete the construction of a shape to give it certain planes of symmetry.

Transformations

Rotation
Rotate a shape with and without a centre of rotation. If the centre is given, then it will be at the centre of the shape or on one of its vertices. Use 90, 180, 270 degrees. Tracing paper is always permissible. Describe a rotation including finding the centre of rotation by trial and improvement. Understand that the image preserves length and angles. Do not use a coordinate grid, but only square paper.

Rotation about any point
Use a square grid to rotate a shape with any centre of rotation. Use 90, 180, 270 degrees. Tracing paper is always permissible. Describe a rotation including finding the centre of rotation by trial and improvement. Understand that the image preserves lengths and angles, i.e. congruent.

Rotation on coordinate axes
Use the coordinate axes to rotate a shape with any centre of rotation. Use 90, 180, 270 degrees. Tracing paper is always permissible. Describe a rotation including finding the centre of rotation by trial and improvement.

Reflection - horizontal or vertical mirror line
Reflect a shape vertically and horizontally on a square grid with a given mirror line. Describe a reflection, including saying where the mirror line is. Understand that the image preserves lengths and angles. The equation of the mirror line is not used.

Reflection - diagonal mirror line
Reflect a shape at 45 degrees on a square grid with a given mirror line. Describe a reflection, including saying where the mirror line is. Understand that the image preserves lengths and angles. The equation of the mirror line is not used.

Reflection - equations of mirror lines
Reflect a shape on a coordinate axes given only the equation of the mirror line, use only equations of the form...
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- Reflect a shape onto an axis.
  Describe a reflection including stating the equation of the mirror line.
  Understand that the image preserves lengths and angles, i.e. congruent

- Enlargement on a grid
  Use a square grid to enlarge with or without a centre of enlargement. Use positive integer scale factors.
  Understand that lengths and perimeter are increased by the scale factor and angles are preserved. Describe an enlargement. Spot, from a set of possible shapes, which ones are enlargements of the original by consideration of the side lengths

- Enlargement on coordinate axes
  Use the coordinate axes to enlarge with or without a centre of enlargement. Use positive integer scale factors.
  Describe an enlargement. Understand that area is not preserved

- Enlargement - fractional scale factors
  Enlarge with or without a centre of enlargement. Use integer and fractional scale factors. Understand that perimeter is increased by the scale factor, but area is not. Describe an enlargement. Understand that an enlargement preserves angles and that the image is similar

- Enlargement - negative scale factors
  Enlarge with a centre of enlargement. Use integer, fractional and negative scale factors. Understand that perimeter is increased by the scale factor, but area is not. Describe an enlargement. Understand that an enlargement preserves angles and that the image is similar

- Translation
  Translate a shape either vertically or horizontally. Describe a translation of this type using simple language. Use only a square grid, not the coordinate axes. Do not use vectors

- Combine translations
  Use a square grid to translate shapes, combinations of vertical and horizontal by following a description (not a column vector). Describe a translation using simple language, e.g. 2up and 3 left. Understand that a translation preserves lengths and angles i.e. congruent

- Translation with a vector
  Use a square grid to translate shapes using a given column vector. Describe a translation using a column vector

- Translation on coordinate axes
  Use the coordinate axes to translate shapes using a given column vector. Describe a translation using a column vector on the coordinate axes

- Combine simple transformations
  Use combinations of transformations, either perform them or describe a set of transformations, limit to 2. Very simple applications, no fractional or negative scale factors of enlargement

- Combine multiple transformations
  Use combinations of transformations, either perform them or describe a set of transformations. More complex examples e.g. More than 2 or involving intersecting images. do not include negative scale factors

- Combine complex transformations
  Use combinations of any transformations, either perform them or describe a set of transformations. Even more complex examples including negative scale factors

- Pythagoras
  - Use Pythagoras’ theorem to find the hypotenuse
    Use Pythagoras theorem in 2D to find the hypotenuse in a right angled triangle using the lengths of the other two sides. Understand a picture proof of the theorem. Include practical problems e.g. ladders and walls
  - Use Pythagoras’ theorem to find the length of a shorter side
    Use Pythagoras theorem in 2D to find one of the shorter sides in a right angled triangle using the lengths of the other two sides.
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other two sides. Include practical problems e.g. ladders and walls

- **Use Pythagoras' theorem in 3D**
  Applications of Pythagoras theorem in 3D to find one of the sides in a right angled triangle. e.g. Diagonal through the centre of a cuboid given the 3 side lengths and a lead into the diagonal of the base. This can be done with a multiple application of Pythagoras in 2D or using the 3D formula for Pythagoras, \( a^2 = b^2 + c^2 + d^2 \). Also include the slanted height of the triangular faces of the side of a square based pyramid, found from the perpendicular height of the pyramid and the base side length

- **Use Pythagoras' theorem to prove a triangle is right angled**
  Use Pythagoras theorem to prove/disprove that a triangle is right angled. Given that a triangle has been proved to be non-right angled, use Pythagoras theorem to prove that the triangle is either acute or obtuse angled

**Trigonometry**

- **Use trigonometry to find lengths**
  Solve problems in 2D involving right angled triangles to find lengths using the 3 trig ratios. Include examples of joined and subdivided shapes. Include examples without a calculator where the trig ratios are given. Include examples involving bearings and angles of depression/elevation

- **Use trigonometry to find angles**
  Solve problems in 2D involving right angled triangles to find angles or trig ratios by using the 3 trig ratios. Include examples of joined and subdivided shapes. Include examples without a calculator. Include examples involving bearings and angles of depression/elevation

- **3D trigonometry**
  Solve problems in 3D involving right angled triangles to find lengths and angles or trig ratios. Include using the angle between a line and a plane. Include examples of joined and subdivided shapes. Include examples without a calculator

- **Use the Sine rule for finding lengths**
  Solve problems in 2D involving non-right angled triangles to find lengths using the Sine rule. Include examples of joined and subdivided shapes. Include examples without a calculator where the trig ratios are given.

- **Use the Sine rule for finding angles**
  Solve problems in 2D involving non-right angled triangles to find angles or the sine of an angle using the Sine rule. Include examples of joined and subdivided shapes. Include examples without a calculator. Include the ambiguous case

- **Use the Cosine rule for finding lengths**
  Solve problems in 2D involving non-right angled triangles to find lengths using the Cosine rule. Include examples of joined and subdivided shapes. Include examples without a calculator where the trig ratios are given.

- **Use the Cosine rule for finding angles**
  Solve problems in 2D involving non-right angled triangles to find angles or the cosine of an angle using the Cosine rule. Include examples of joined and subdivided shapes. Include examples without a calculator

**Speed, distance, time**

- **Speed, distance and time calculations**
  Solve problems involving speed, distance and time using the formula, speed = distance/time and a calculator. Know the units of speed can be written in two ways (e.g. m/s and ms\(^{-1}\)). Solve problems involving the conversion of units e.g. expressing 1 hr 25 min as a decimal number of hours. Also solve problems without a calculator using ratio to change the question into the required solution e.g. 10m in 10 sec into a speed in km/hr

- **Distance/time graphs**
  Draw, complete and interpret distance or displacement / time graphs for constant speed. Find the speed by
finding the gradient or measuring the distance covered in a certain time period and converting to a single unit of time. Understand that the steeper the gradient, the greater the speed and understand the difference between positive and negative gradients

- **Speed/time graphs**
  Draw, complete and interpret speed or velocity / time graphs for constant acceleration

- **Density**
  - **Density formula**
    Solve problems involving density as mass per unit volume. Know the formula and the units that will result (i.e. kg/m$^3$ and kg m$^{-3}$)
  - **Population density**
    Solve problems involving population density i.e. number of people per square unit of area. Know the formula and the units that will result (i.e. people/m$^2$)

- **Vectors**
  - **Column vectors**
    Find the sum, difference and scalar multiple of column vectors and represent the results graphically. Include the arrow, bold and underlined notation
  - **Vector algebra**
    Find the sum, difference and scalar multiple of vectors expressed algebraically (in bold or underlined form), include use of the arrow notation. Include fractional parts of vectors and the reverse of a vector (i.e. multiplication by -1). Represent the results graphically
  - **Vector problems**
    Solve vector problems in 2D with the aid of a diagram. Find new algebraic vector representations for journeys between different vertices. Include the division of lines using ratio, in particular midpoints and thirds or quarters
  - **Parallel vectors**
    Prove 2 vectors are parallel or otherwise by attempting to use scalar multiples of each vector and thus draw conclusions as to the properties of a shape including its name, e.g. a trapezium based on two vectors being proved as parallel
  - **Prove 3 points lie on a line**
    Show (or disprove) that 3 points lie on the same line using vectors, i.e. co-linear. Can be done by examining any of the 2 vectors that join the points and checking if they are parallel

- **Understanding properties of shape**
  - **Compare and order angles**
    Compare and order angles less than 180 degrees
  - **Recognise perpendicular and parallel lines**
    Recognise parallel and perpendicular lines in grids and shapes
  - **Calculating angles around a point**
    Know that angles are measured in degrees and that one whole turn is 360 degrees. Calculate angles at a point
  - **Straight line angles**
    Recognise that angles at a point on a straight line total 180 degrees
  - **Describe 2D shapes**
Identify, visualise and describe properties of quadrilaterals, triangles and regular polygons. Recognise geometrical features of 2-D shapes including angles, pairs of parallel lines and symmetry, and use these to classify shapes and solve problems

- **Describe 3D shapes**
  Describe, identify and visualise parallel and perpendicular edges or faces; use these properties to classify 3-D solids

- **Sort and describe shapes**
  Visualise common 2-D shapes and 3-D solids; identify shapes from pictures of them in different positions and orientations; sort and describe shapes, referring to their properties

- **Draw shapes and patterns on a grid**
  Make, draw and identify with increasing accuracy 2-D shapes and patterns on different orientations on a grid

- **Investigate faces, edges and vertices in 3D shapes**
  Make, draw and identify with increasing accuracy 3-D shapes and patterns linking given faces and edges. Represent and interpret sequences, patterns and relationships involving shapes

- **Estimate angles**
  Estimate angles

### Transforming shapes

- **Understand position, direction and movement**
  Follow and give instructions involving position, direction and movement

- **Use compass directions**
  Read and record the vocabulary of position, direction and movement, using the four compass directions to describe movement about a grid

### Understanding measures

- **Choose and estimate measures**
  Recognise the need for standard units of length, mass and capacity, choose which ones are suitable for a task, and use them to make sensible estimates in everyday situations

- **Change between units of measurement**
  Select and use standard metric units of measure and convert between units using decimals to two places (e.g. change 2.75 litres to 2750 ml, or vice versa)

- **Recognise that measurement is approximate**
  Recognise that measurement is approximate

- **Use measuring equipment**
  Choose and use suitable measuring instruments for a task

- **Record measurements**
  Record measurements using decimal notation

### Time

- **Use 24-hour clock times**
  Read timetables and time using 24-hour clock notation

- **Use calendars and dates**
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Use a calendar and dates to calculate time intervals

- Measure time
  Read time to the nearest minute; use am, pm and 12-hour clock notation; choose units of time to measure time intervals; calculate time intervals from clocks and timetables. Use units of time (seconds, minutes, hours, days) and know the relationships between them

- Area and perimeter
  - Find the area of a rectangle
    Use the formula for the area of a rectangle to calculate the rectangle's area
  - Estimate the area of shapes
    Estimate the area of an irregular shape by counting squares

- Pyramid Panic
  - Lengths and areas with circles & triangles
    Solve problems with the radius and diameter of circles. Solve problems with length, perimeter and area of triangles.
  - Lengths and areas in quadrilaterals
    Solves problems with length, perimeter and area of quadrilaterals.
  - Pythagoras' Theorem
    Solve problems involving finding the length of a side of a right angled triangle using Pythagoras theorem. Give answers in an exact form.
  - Trigonometry ratios
    Solve problems involving finding the 3 trigonometric ratios sin, cos and tan in their simplest forms.

- Pyramid Panic Lite
  - Lengths in circles
    Understand the relationship between the length of the radius and the diameter of a circle.
  - Area of squares & rectangles
    Understand how to calculate the area of a square and a rectangle. Find the missing side length of a square if the area is known. Find the missing side length of a rectangle if the area and one other side length are known.
  - Perimeter of triangles
    Understand how to calculate the perimeter of a triangle. Find the side length of an equilateral triangle if the perimeter is known. Find the missing side length of a scalene triangle if the perimeter and two other side lengths are known.
  - Perimeter of squares & rectangles
    Understand how to calculate the perimeter of a squares and rectangles. Find the side length of a square if the perimeter is known. Find the missing side length of a rectangle if the perimeter and one side length are known.

- Transtar
  - Reflections, rotations & translations
    Perform and predict the movements described by reflections, rotations and translations.
Introducing integer/fractional enlargements
Perform and predict the movements described by reflections, rotations, translations, integer and fractional scale factor enlargements.

Introducing negative enlargements
Perform and predict the movements described by reflections, rotations, translations, integer, fractional and negative scale factor enlargements.

Advanced composition: all types
Perform and predict the movements described by combinations of any of the transformations: reflections, rotations, translations, enlargements of any scale factor.

Trig functions

Radian measurement
Learn important angles in terms of radians. Understand the relationship and convert between degrees and radians.

Arc length using radians
Find the length of an arc using radian measurement. Use the formula arc length = radius * angle

A Tangled Web

Basic angle rules
Solve problems involving right angles, angles on a line, angles at a point and vertically opposite angles.

Angles and parallel lines
Solve problems involving angles and parallel lines. Understand the rules for corresponding, alternate and allied angles.

Angles in triangles
Solve problems involving angles in a triangle. Understand the different angle rules for a scalene, isosceles and equilateral triangle.

Angles in quadrilaterals
Solve problems involving angles in a quadrilateral. Understand the different angle rules for a square, rectangle, rhombus, parallelogram, kite and trapezium.

Angles in polygons
Solve problems involving interior and exterior angles of polygons. Understand the angle rules for regular polygons.

Angles in circles
Solve problems involving angles in circles. Include the following rules: right angle in a semi circle, angles in the same segment, angles at the centre, perpendicularity of tangent and radius, alternate segment theorem.

Probability

Probability scale
Express probability as decimals, fractions or percentage between 0 and 1 and understand the concept of the position on the number line. Use words to describe probability and place them appropriately on a number line, e.g. Likely, fifty-fifty

Random and bias events
Understand what is meant by random (i.e. different results may occur from repeating the same experiment) and bias events and recognise them in a practical context
○ Listing possible outcomes from a single event
  List all possible equally likely outcomes for one event. The terms sample space, possibility space, probability space need to be known

○ Listing all possible outcomes
  List all possible equally likely outcomes for successive events including using a 2 way table. The terms sample space, possibility space, probability space need to be known. Include tossing coins and combinations from a menu and 2 dice rolls

○ The probability of an event not happening
  Use \( (1 - \text{probability of event}) \) to find probability of the event not occurring

○ Probability of single events
  Calculate probability for single events based on theoretical models i.e. \( \frac{\text{number of favourable outcomes}}{\text{number of possible outcomes}} \). Make use of a sample space to find the probability, generally of equally likely events. Use the formula \( P(A \text{ or } B) = P(A) + P(B) \) for mutually exclusive events. Include examples of a probability of an event on an unbiased spinner or coloured balls in a bag. Include examples where the probability is given and the number of items needs to be found (simple cases only)

○ Probability from two way tables
  Calculate probabilities from a 2 way table or frequency table that shows either the number of items in each category or the probability of selecting a particular category. Include questions that involve non mutually exclusive events e.g. coloured balls in a bag have a number on them. Find the probability a ball chosen at random is green or has a number 2 on it or is both green and has a number 2 on it.

○ Probability of repeated events - one outcome
  Calculate probabilities of successive independent or dependent events using \( P(A \text{ and } B) = p(A) \times p(B) \) or \( p(A \text{ and } B) = p(A) \times p(B \text{ if } A \text{ has happened}) \) without reference to tree diagrams. The formula notation is not needed. Use the multiplication formula to prove/disprove events are independent. Restrict examples to only one overall outcome, i.e. do not sum separate overall events

○ Probability of repeated events - multiple outcomes
  Calculate probabilities of successive independent or dependent events using \( P(A \text{ and } B) = p(A) \times p(B) \) or \( p(A \text{ and } B) = p(A) \times p(B \text{ if } A \text{ has happened}) \) without reference to tree diagrams. The formula notation is not needed. Use the multiplication formula to prove/disprove events are independent. Use examples where you need to sum the overall probability of mutually exclusive outcomes made from successive events

○ Tree diagrams - independent events
  Draw a tree diagram for independent events. Find the probability of successive events occurring using the branches of the tree diagram. Include multiplication of both decimals or fractions with and without a calculator. Find the probability of more than one mutually exclusive overall outcome occurring by summing the required results

○ Tree diagrams - conditional events
  Draw a tree diagram for conditional events. Find the probability of more than one successive event occurring using the branches of the tree diagram. Include multiplication of both decimals or fractions with and without a calculator. Find the probability of more than one mutually exclusive overall outcome occurring by summing the required results

○ Experimental probability
  Estimate probability by collecting results from an experiment. Compare a result from an experiment with what is expected. Understand that if an experiment is repeated the outcome maybe different. Understand that increasing the number of trials increases the reliability of the probability estimate

○ Relative frequency
  Calculate the relative frequency of an event for a changing number of trials. Understand that the relative frequency gives an estimation of the probability of an event. Calculate the expected number of outcomes for an event based on a fixed number of trials. Draw and interpret a graph showing the relative frequency plotted against the number of trials. Understand that the variations will settle down as the number of trials increase
All Prodigi Lessons

- **Understand the likelihood of events**
  Understand and use the probability scale from 0 to 1; find and justify probabilities based on equally likely outcomes in simple contexts

- **Use the language of probability**
  Describe and predict outcomes from data using the language of chance or likelihood

- **Venn diagrams in probability**
  Australian teaching objective

- **Measuring and comparing data**
  - **Find the mode**
    Find the mode from raw data or a frequency table. There may be more than one mode or no mode. The mode may also be non-numerical
  
  - **Find the modal class interval**
    Find the modal class interval from a grouped frequency table. There may be more than one modal class interval or no modal class interval
  
  - **Find the median**
    Calculate the median from raw data. There may be a middle result, or a pair of results in the middle. Understand that the median need not be one of the actual results
  
  - **Find the median from a table**
    Calculate the median from a frequency table. There may be a middle result, or a pair of results in the middle. Understand that the median need not be one of the actual results
  
  - **Find the class interval containing the median**
    Find the class interval that contains the median from a grouped frequency table
  
  - **Find the mean**
    Calculate the mean from raw data. The data may be expressed in a list or other format showing all the data results. Understand that the mean need not be one of the possible results, e.g. it could be a decimal. Include using a simple coded/assumed mean
  
  - **Find the mean from a table**
    Calculate the mean from a frequency table or equivalent representation showing the frequency of each result e.g. a bar chart. Calculate or interpret the sum of the frequency multiplied by the result. Complete a third row in the frequency table to show the separate calculations. Understand that the mean need not be one of the actual results e.g. it can be a decimal. Include using a simple coded/assumed mean
  
  - **Estimate the mean using grouped results**
    Calculate an estimate of the mean from a grouped frequency table or equivalent representation showing the frequency of each class interval e.g. a bar chart or cumulative frequency table. Understand why the mid-point of each interval is used and the implications for the answer. Calculate or interpret the sum of the frequency multiplied by the mid-point. Complete a third row in the frequency table to show the separate calculations. Understand that the mean need not be one of the actual results e.g. it can be a decimal. Round the estimated mean to a sensible degree of accuracy. Include using a simple coded/assumed mean
  
  - **Use the mean to solve problems**
    Use the value of the mean to find the total of the data set including algebraically. Combine more than one data set to find the overall mean or reverse problems
  
  - **Moving averages**
    Find the (mean) moving average for a series of results over a period of time. Most commonly for 3, 4 or 5 points. Draw a graph of the moving averages by plotting them in the middle of the points that were used to calculate them. Understand why moving averages are used and know their advantages and disadvantages in representing
a trend. Use the graphs to make predictions

- **Find the range**
  Calculate the range of a set of data. Include estimating the range from grouped data

- **Find the quartiles and Inter quartile range**
  Find the lower quartile, upper quartile and inter quartile range of a set of data represented in various forms that show all the data values. e.g. raw data list, stem and leaf diagram, frequency table. Understand the advantages and disadvantages of using the inter quartile range as a measure of spread. Understand that the middle 50% of results lie between the upper and lower quartiles and interpret the meaning of the quartiles

- **Measures of variation: IQR and standard deviation**
  Australian teaching objective

### Representing data

- **Interpret raw data**
  Read data from lists and tables, one way only (Carroll diagrams, although this term need not be known). Include Venn diagrams for sorting data, (although this term need not be known). Deal with missing results and recognise outliers

- **Two way tables**
  Design, use and interpret two way tables for recording and sorting discrete data

- **Frequency tables**
  Draw up and interpret frequency tables and group data into class widths using discrete data. Understand which data represents the results and which represents the frequency.

- **Stem and leaf diagrams**
  Draw up and interpret stem and leaf diagrams. Include data like 34, 3.4 and 3400. Include a key to the data. Include back to back stem and leaf diagrams. Diagrams should be ordered

- **Bar charts**
  Use discrete data and understand how a bar chart and vertical line graph represent frequency. Understand that both graphs are a type of frequency diagram. Draw and interpret these graphs. Include dual bar charts, although this term need not be known. Include horizontal bar charts

- **Line graphs**
  Use line graphs that are frequency diagrams. Draw and interpret these line graphs. Understand that the plotted points, when joined, give a trend. Limit examples to those that have meaning when interpolated between the intervals. Do not include time series graphs

- **Frequency polygons and time series graphs**
  Understand how a frequency polygon/time series graph represents frequency. Understand that the graph is a type of frequency diagram. Draw and interpret frequency polygons based on time (i.e. time series graphs). Understand that the plotted points, when joined, give a trend over time. Know when it is and is not appropriate to interpolate between the plotted points. Know the term frequency polygon. Use frequency polygons to progress an enquire

- **Pictograms**
  Construct and read pictograms. Understand how they can be misleading and use a key

- **Scatter diagrams**
  Draw and read scatter diagrams. Draw conclusions from the graph, including examples where the line of best fit is already drawn

- **Correlation**
  Understand the difference between negative, positive and zero correlation. Understand that correlation does not imply that one variable is causing the other the vary. Describe correlation as weak, moderate, strong, perfect.
Understand that using the line of best fit to predict results outside the given data range is unreliable, as is using the line of best fit to predict results inside the data range if the correlation is weak. Recognise that some correlations may not be linear

- **Lines of best fit**
  Draw a line of best fit by eye and understand that it should only be extended through the given data and not be forced through the origin. Attempt to have as many points above as below the line, but deal with outliers in a sensible way. Use lines of best fit to progress an enquiry

- **Box plots (Box and whisker diagrams)**
  Construct and interpret a box plot (box and whisker diagram)

- **Pie charts**
  Read off results from pie charts and percentage pie charts. Include measuring the angle to find a proportion and calculate the size of a different category. Discuss advantages and disadvantages and interpret meaning. Understand that the amount that each sector represents should be shown, otherwise only proportional relationships can be inferred

- **Cumulative frequency diagrams**
  Draw a cumulative frequency graph. May be asked to draw a graph/diagram/curve or polygon. When dealing with uneven class widths and a large initial class width, use a hanging curve, i.e. do not plot the lower bound of the first interval. When using a final open class interval, make a sensible approximation. And find the median, lower quartile, upper quartile, IQR and other measures from the cumulative frequency graph. Divide the data into common fractions or percentages

- **Drawing histograms**
  Draw a histogram and understand that they are used for continuous measures. Decide on the bounds of the class intervals.

- **Interpreting histograms**
  Read results off a histogram and understand the meaning of frequency density. Complete a table of grouped frequency from the histogram by comparing a corresponding bar and class interval to decide on the frequency density scale. Take simple readings from the histogram that involve whole bars or simple fractions of a bar

### Questionnaires and sampling

- **Data collection sheets**
  Design a data collection sheet for a survey including a 2 way table and tally. Questions will be of a very basic nature. Sheet can be used to record the results from a large number of people

- **Questionnaires**
  Design a questionnaire and select appropriate questions. Understand that questions must not be vague or ambiguous. They must have a clearly defined response section. Must not be biased/leading. Must not be too personal. Include the use of intervals to help ask personal questions, e.g. age 40 to 59. Make suggestions on how to change a given questionnaire in order to improve it

- **Practical ways to carry out a survey**
  Know and understand the advantages and disadvantages of each of the following practical sampling methods:- asking friends, telephone, email, post, door to door, on the street, observation, controlled experiment, data logging etc. Understand the term biased and how it can be reduced when using each different sampling method. Deal with non-response or missing data

- **Sample size**
  Know that a larger sample means more accurate results.

- **Random sampling**
  Understand that each member of the population must have an equal chance of being picked for the sample to be random. Explain the way in which a random sample can be carried out e.g. assigning a number to each member of the population and generating random numbers. Understand that a random sample can produce a biased set
All Prodigi Lessons

- Stratified sampling
  Understand what is meant by 'stratified sampling'. Choose the appropriate number from each strata to be sampled. The term strata need not be known. Make decisions about rounding e.g. when rounding each strata sample size to the nearest integer, the total sample size maybe too big or too small and need adjusting.

- Hypotheses
  Understand that a hypothesis means a statement that is believed to be true, but that can be tested using data. Know the term 'hypothesis'. Use 'conjecture' in the same way, but the term need not be known since the sense will be given. Suggest a simple hypothesis.

- Dealing with data
  - Sort objects
    Solve problems involving data by sorting objects and classify them using more than one criterion.
  - Test a hypothesis
    Collect and sort data to test a simple hypothesis.
  - Understand discrete and continuous data
    Recognise the difference between discrete and continuous data. Understand the differences between collecting sets of discrete and continuous data.

- Graphs, tables and lists
  - Record results
    Record results in tables, lists and charts used in everyday life.
  - Use pictograms and block graphs
    Record results in pictograms (where a picture represents just 1 item) and block graphs. Not including time series.
  - Interpret data
    Solve problems by collecting, selecting, processing, presenting and interpreting raw data and data in tables and lists.
  - Interpret data using graphs and diagrams
    Interpret discrete data using a wider range of graphs and diagrams (not including pictograms, bar charts or line graphs as these are covered else where). Not including time series.
  - Use Carroll and Venn Diagrams
    Use Venn and Carroll diagrams to record sorting and classifying of information.
  - Use line graphs
    Represent and interpret discrete data using line graphs. Not including time series.
  - Use pie charts
    Represent and interpret pie charts.
  - Use frequency tables
    Construct and interpret frequency tables (do not include grouped data) or frequencies over time.
  - Interpret events over time
    Construct frequency tables, pictograms and bar and line graphs to represent the frequencies of events and changes over time.
  - Recognise misleading data
Recognise when information is presented in a misleading way

- **Averages and range**
  - **Calculate the mode**
    Describe and interpret results and solutions to problems using the mode
  - **Calculate the median**
    Describe and interpret results and solutions to problems using the median
  - **Use the range and mode**
    Describe and interpret results and solutions to problems using the mode and the range