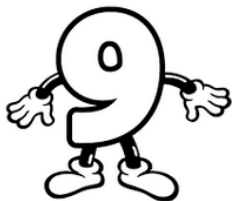


Stage 9

Title Pages
for pupil exercise books



Calculating

The study of stars, moons and planets involves huge numbers. Astronomers use standard form to write very large quantities. This makes it easier for them to compare the quantities and it allows them to calculate with and without calculators. The sun has a mass of 1.988×10^{30} kg. This is a number with 27 zeros and it would be clumsy and impractical to have to write it out each time you wanted to use it.



Powers and Roots

You will learn to calculate with powers and roots

- Calculate with positive indices (roots) using written methods
- Use a calculator to evaluate numerical expressions involving powers (roots)

Standard form

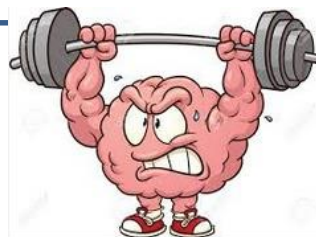
You will explore the use of standard form

- Interpret a number written in standard form
- Calculate with negative indices in the context of standard form
- Add (subtract) numbers written in standard form
- Multiply (divide) numbers written in standard form
- Convert a 'near miss' into standard form; e.g. 23×10^7
- Enter a calculation written in standard form into a scientific calculator
- Interpret the standard form display of a scientific calculator

Accuracy

You will explore the effects of rounding

- Understand the difference between truncating and rounding
- Identify the minimum and maximum values of an amount that has been rounded (to nearest x, x d.p., x s.f.)
- Use inequalities to describe the range of values for a rounded value
- Solve problems involving the maximum and minimum values of an amount that has been rounded

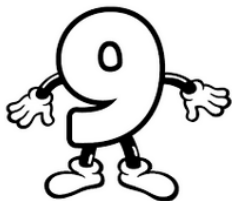


Power
Root
Index, Indices
Standard form
Inequality
Truncate
Round
Minimum,
Maximum
Interval
Decimal place
Significant figure

Mastery Indicators

9BAM1

Powers and roots



Visualising and constructing

Daughtspeople and architects need to draw accurate scale diagrams of the buildings and other structures they are working on. Although the drawings are complicated they still use ordinary mathematical instruments such as rulers and compasses.



Constructions

You will need to know how to complete the standard mathematical constructions

- Use compasses to construct clean arcs
- Use ruler and compasses to construct the perpendicular bisector of a line segment
- Use ruler and compasses to bisect an angle
- Use a ruler and compasses to construct a perpendicular to a line from a point (at a point)

Loci

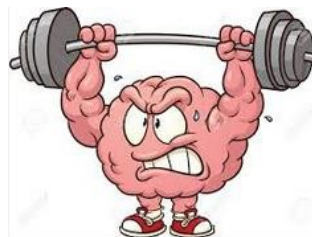
You will learn how to apply these standard mathematical constructions to solve problems

- Understand the meaning of locus (loci)
- Know how to construct the locus of points a fixed distance from a point (from a line)
- Identify when to use the locus of points a fixed distance from a point (from a line)
- Identify when a perpendicular bisector is needed to solve a loci problem
- Identify when an angle bisector is needed to solve a loci problem
- Choose techniques to construct 2D shapes; e.g. rhombus
- Combine techniques to solve more complex loci problems

Plans and Elevations

You will explore ways of representing 3D shapes in 2D

- Construct a shape from its plans and elevations
- Construct the plan and elevations of a given shape
- Know how to deal with a change in depth when dealing with plans and elevations



C_m_p_sses

Arc

L_ne s_gm_nt

P_rpendicular

Bis_ct

Perpendicular

b_s_ct_r

Locus, Loci

Pl_n

El_v_t__n

Mastery Indicators

9BAM8
Construction



Visualising and constructing

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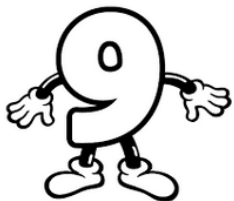
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C_m_p_sses
Arc
L_ne s_gm_nt
P_rpendicular
Bis_ct
Perpendicular
b_s_ct_r
Locus, Loci
Pl_n
El_v_t__n

Mastery Indicators

9BAM8
Construction



Algebraic Proficiency: Tinkering



Situations that involve motion, including acceleration, stopping distances, velocity and displacement can be modelled using quadratic expressions and formulae. Police road accident investigators measure skid marks and apply an equation to work out the speed at which the accident occurred.

Identities

- You will discover the difference between equations and identities
- Understand the meaning of an identity
- Work out why two algebraic expressions are equivalent
- Know how to set up an mathematical argument
- Create a mathematical argument to show that two algebraic expressions are equivalent

Manipulating Quadratics

- You will learn how to manipulate quadratics expressions
- Multiply two linear expressions of the form $(x + a)(x + b)$
- Multiply two linear expressions of the form $(x \pm a)(x \pm b)$
- Expand the expression $(x \pm a)^2$
- Simplify an expression involving 'x²' by collecting like terms
- Identify when it is necessary to remove factors to factorise a quadratic expression
- Identify when it is necessary to find two linear expressions to factorise a quadratic expression
- Factorise a quadratic expression of the form $x^2 + bx + c$

Formulae

- You will use apply your algebra skills to create and use formulae in different situations
- Construct algebraic statements
- Identify variables in a situation
- Distinguish between situations that can be modelled by an expression or a formula
- Create an expression or a formula to describe a situation

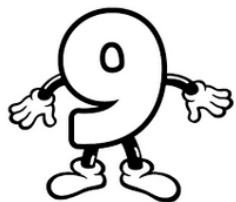


WORDS

In_quality
Identity
Eq__valent
Equat__n
F_rm_l_,
Formulae
Expr_ss__n
_xp_nd
L_n__r
Quadratic

Mastery Indicators

9BAM2
Expanding
9BAM3
Factorising



Proportional Reasoning

When you enlarge a photo, project an image on a screen or make scale models you are dealing with similarity. Many toys and other objects are scaled similar versions of larger objects.



Direct and Inverse proportion

You will solve problems involving different types of proportion and investigate ways of representing proportion

- Know the difference between direct and inverse proportion
- Recognise direct (inverse) proportion in a situation
- Know the features of a graph that represents a direct (inverse) proportion situation
- Know the features of an expression (or formula) that represents a direct (inverse) proportion situation
- Understand the connection between the multiplier, the expression and the graph

Similar shapes

You will understand and solve problems involving congruence and similarity

- Know the meaning of congruent (similar) shapes
- Identify congruence (similarity) of shapes in a range of situations
- Identify the information required to solve a problem involving similar shapes
- Finding missing lengths in similar shapes

Compound Units

You will learn how to use compound units in a range of situations

- Understand why speed, density and pressure are known as compound units
- Know the definition of density (pressure, population density, speed)
- Solve problems involving density (pressure, speed)
- Convert between units of densities



Direct proportion
Inverse proportion
Multiplier
Length
Congruent,
Congruence
Similar, Similarity
Compound unit
Density, Population
density
Pressure

Mastery Indicators

8BAM9
Similar area
9BAM7
Compound units



Pattern Spotting

Finding a pattern and working out how the parts of a pattern fit together is important in scientific discovery. Scientists use sequences to model and solve real life problems, such as estimating how quickly a disease will spread.



WORDS

T_{rm}
Term-to-term rule
P_{sition-to-t_{rm}} rule
nth term
G_{nerate}
Linear
Q_{u_{dr}t_c}
F_{rst} (second) difference
F_{bona_{_i}} number
Fib_{na_{_i}} sequence

Nth term of a linear sequence

You will explore how do describe any term in a linear sequence

- Generate a sequence from a term-to-term rule
- Understand the meaning of a position-to-term rule
- Use a position-to-term rule to generate a sequence
- Find the position-to-term rule for a given sequence
- Use algebra to describe the position-to-term rule of a linear sequence (the nth term)
- Use the nth term of a sequence to deduce if a given number is in a sequence
- Generate a sequence using a spreadsheet

Fibonacci Sequences

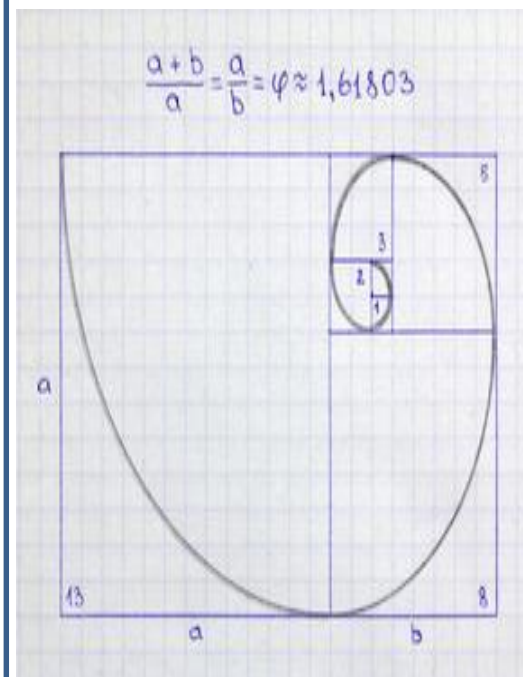
You will investigate Fibonacci numbers and Fibonacci type sequences

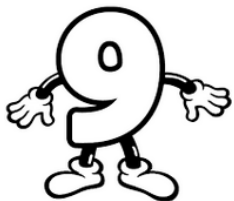
- Recognise Fibonacci numbers
- Recognise the Fibonacci sequence
- Generate Fibonacci type sequences
- Find the next three terms in any Fibonacci type sequence

Quadratic Sequences

You will explore quadratic sequences

- Substitute numbers into formulae including terms in x^2
- Generate terms of a quadratic sequence from a written rule
- Generate terms of a quadratic sequence from its nth term
- Identify quadratic sequences
- Establish the first and second differences of a quadratic sequence
- Find the next three terms in any quadratic sequence





Solving equations and inequalities 1

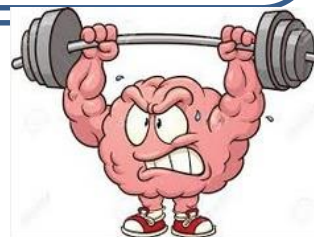
Inequalities are one way of showing the ranges of values that have to be met and considered in running a successful business. For example, a business might want wastage to be below a certain figure or profit to be greater than or equal to a given figure.



Inequalities

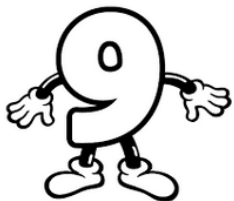
You will explore the meaning of an inequality and learn to solve inequalities

- Understand the meaning of the four inequality symbols
- Choose the correct inequality symbol for a particular situation
- Represent practical situations as inequalities
- Recognise a simple linear inequality
- Find the set of integers that are solutions to an inequality
- Use set notation to list a set of integers
- Use a formal method to solve an inequality
- Use a formal method to solve an inequality with unknowns on both sides
- Use a formal method to solve an inequality involving brackets
- Know how to deal with negative number terms in an inequality
- Know how to show a range of values that solve an inequality on a number line
- Know when to use an open circle at the end of a range of values shown on a number line
- Know when to use an filled circle at the end of a range of values shown on a number line
- Use a number line to find the set of values that are true for two inequalities



(Linear)
inequality
Unknown
Manipulate
Solve
Solution set
Integer

Mastery Indicators



Calculating Space

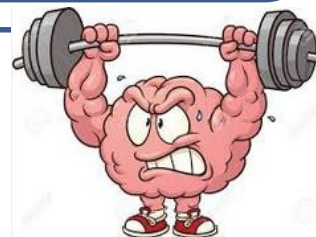
Builders, carpenters, garden designers and navigators use Pythagoras' Theorem in their jobs. It is a method based on a right angled triangle that allows them to work out unknown lengths.



Perimeter, Area and Volume

You will learn how to solve problems involving arcs and sectors and prisms

- Know the vocabulary of circles
- Know how to find arc length
- Calculate the arc length of a sector when radius is given
- Know how to find the area of a sector
- Calculate the area of a sector when radius is given
- Calculate the angle of a sector when the arc length and radius are known
- Know how to find the surface area of a right prism and cylinder
- Calculate the surface area of a right prism and cylinder
- Calculate exactly with multiples of π



Pythagoras' Theorem and Trigonometry You will investigate right-angled triangles and learn how to solve problems involving Pythagoras' theorem

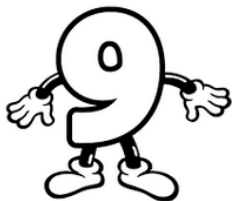
- Know Pythagoras' theorem and the formula triangles for SOH CAH TOA
- Identify the hypotenuse, adjacent and opposite in a right-angled triangle
- Know when to apply Pythagoras' and when to apply Trigonometry theorem
- Calculate the hypotenuse of a right-angled triangle using Pythagoras' theorem
- Calculate one of the shorter sides in a right-angled triangle using Pythagoras' theorem
- Calculate missing sides and angles using Trigonometry



Circle, Pi
Radius,
diameter, chord,
circumference,
arc, tangent,
sector, segment
(Right) prism,
cylinder
Cross-section
Hypotenuse
Pythagoras'
theorem

Mastery Indicators

9BAM10 Using π
9BAM11
Pythagoras'
Theorem
9BAM
Trigonometry



Proof

Mathematical proof is proceeding in logical steps, establishing a series of mathematical statements by using facts that are already known to be true.



Congruence

You will explore the congruence of triangles and investigate geometrical situations

- Know the criteria for triangles to be congruent (SSS, SAS, ASA, RHS)
- Identify congruent triangles

Proof

You will learn how to form mathematical arguments and prove them mathematically

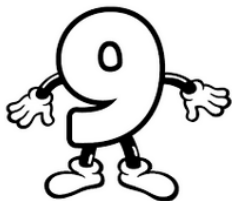
- Use known facts to form conjectures about lines and angles in geometrical situations
- Use known facts to derive further information in geometrical situations
- Test conjectures using known facts
- Know the structure of a simple mathematical proof
- Use known facts to create simple proofs
- Explain why the base angles in an isosceles triangle must be equal
- Explain the connections between Pythagorean triples



Congruent,
congruence
Similar (shapes),
similarity
Hypotenuse
Conjecture
Derive
Prove, proof
Counterexample

Mastery Indicators

9BAM12
Proof



Algebraic Proficiency: Visualising

All sorts of information can be obtained from graphs in real life contexts. The shape of a graph, its gradient and the area underneath can tell us about speed, time, acceleration, prices, earnings, break even points or the value of one currency against another,



Linear Graphs

You will investigate features of straight line graphs

- Use the form $y = mx + c$ to identify parallel lines
- Rearrange an equation into the form $y = mx + c$
- Find the equation of a line through one point with a given gradient
- Find the equation of a line through two given points
- Interpret the gradient of a straight line graph as a rate of change

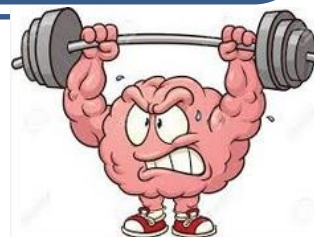
Curved Graphs

You will explore graphs of quadratic functions and other nonlinear functions

- Explore graphs of other standard non-linear functions
- Create and use graphs of non-standard functions
- Plot graphs of quadratic (cubic, reciprocal) functions
- Recognise and interpret the graphs of quadratic (cubic, reciprocal) functions
- Sketch graphs of quadratic (cubic, reciprocal) functions
- Plot and interpret graphs of non-standard functions in real contexts

Kinematics

- You will use graphs to solve about objects in motion
- Plot and interpret graphs of non-standard functions in real contexts
- Find approximate solutions to kinematic problems involving distance, speed and acceleration

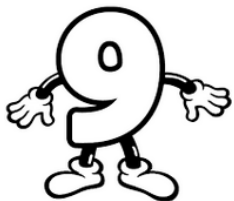


WORDS

Function, equation
Linear, non-linear
Quadratic, cubic,
reciprocal
Parabola, Asymptote
Gradient, y-
intercept, x-
intercept, root
Rate of change
Sketch, plot
Kinematic Speed,
distance, time
Acceleration,
deceleration

Mastery Indicators

9BAM4
Linear graphs
9BAM6
Curved graphs



Solving equations and inequalities 2

Without algebra, humans would not have reached the moon and planes would not fly. Defining numbers with letters allows mathematicians to use formulae and solve very complicated equations that are needed for today's technology.



Simultaneous Equations

You will learn how to solve simultaneous equations graphically and algebraically

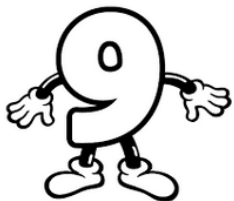
- Understand that there are an infinite number of solutions to the equation $ax + by = c$ ($a \neq 0, b \neq 0$)
- Understand the concept of simultaneous equations
- Find approximate solutions to simultaneous equations using a graph
- Understand the concept of solving simultaneous equations by elimination*
- Target a variable to eliminate
- Decide if multiplication of one equation is required
- Decide whether addition or subtraction of equations is required
- Add or subtract pairs of equations to eliminate a variable
- Find the value of one variable in a pair of simple simultaneous equations
- Find the value of the second variable in a pair of simple simultaneous equations
- Solve two linear simultaneous equations in two variables in very simple cases (no multiplication required)
- Solve two linear simultaneous equations in two variables in simple cases (multiplication only required)
- Derive and solve two simultaneous equations
- Interpret the solution to a pair of simultaneous equations



Equation
Simultaneous
equation
Variable
Manipulate
Eliminate
Solve
Derive
Interpret

Mastery Indicators

9BAM5
Simultaneous
equations



VECTORS

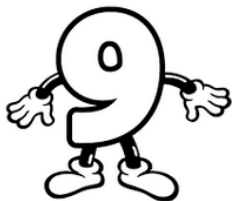
A Vector is an object that has both a magnitude and direction . Geometrically, we can picture a vector as a directed line segment, whose length is the magnitude of the vector and with an arrow indicating the direction. Vectors are used to describe complex systems such as fluid dynamics, quantum mechanics and meteorology

- Understand how vectors can be represented (both graphically and via mathematical notation)
- Add and subtract vectors
- Know the definition of a resultant vector
- Find the magnitude of a vector
- Multiply by scalar quantities
- Understand what makes a vector parallel to another



Addition
Subtraction
Vector
Magnitude
Direction
Coordinate
Velocity
Vector product
Scalar
Parallel
resultant

Mastery Indicators



Understanding risk

Understanding probability will help you when playing games based on chance. In the 17th century Blaise Pa and Pierre de Fermat developed probability theory at the request of gamblers.



Tree Diagrams

You will learn how to use tree diagrams to solve probability problems involving combined events and use probability to make predictions

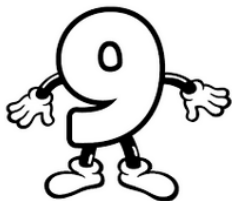
- List outcomes of combined events using a tree diagram
- Label a tree diagram with probabilities
- Label a tree diagram with probabilities when events are dependent
- Know when to add two or more probabilities
- Know when to multiply two or more probabilities
- Use a tree diagram to calculate probabilities of independent combined events
- Use a tree diagram to calculate probabilities of dependent combined events
- Understand that relative frequency tends towards theoretical probability as sample size increases



Outcome, equally likely outcomes
Event, independent event, dependent event
Tree diagrams
Theoretical probability
Experimental probability
Random
Bias, unbiased, fair
Relative frequency
Enumerate
Set

Mastery Indicators

9BAM13
Tree Diagrams



Presentation of data

We live in an information rich world. Knowing how to construct accurate graphs and how to interpret data is important. Many graphs in newspapers are carefully designed to influence what we think by displaying the data in a particular way.



Scatter diagrams, correlation and time series graphs

You will construct and interpret graphs of time series data, interpret scatter diagrams and explore correlation

- Construct graphs of time series
- Interpret graphs of time series
- Construct and interpret compound bar charts
- Interpret a wider range of non-standard graphs and charts
- Understand that correlation does not indicate causation
- Interpret a scatter diagram using understanding of correlation
- Construct a line of best fit on a scatter diagram
- Use a line of best fit to estimate values
- Know when it is appropriate to use a line of best fit to estimate values



Categorical data, Discrete data
Continuous data,
Grouped data
Axis, axes
Time series
Compound bar chart
Scatter graph (scatter diagram, scattergram, scatter plot)
Bivariate data
(Linear) Correlation
Positive correlation,
Negative correlation
Line of best fit
Interpolate
Extrapolate
Trend

Mastery Indicators



Title Title Title Title

Big Ideas



Keywords

I will be successful if I can:-



Mastery Indicators