



Year 13 Mathematics – Algebraic Methods

Learning about this topic is important because:

Being able to manipulate algebraic fractions is important to understand and use partial fractions. Partial fractions are useful for simplifying complex functions into forms which are easier to integrate and differentiate.

This builds on: Algebraic Expressions Y12: Factorising, Algebraic Methods Y12: Simplifying algebraic fractions

This leads to: Sequences and Series Y13, Binomial Expansion Y13, Integrations and differentiation of more complex functions

We will learn:

- Multiply and divide two or more algebraic fractions
- Add or subtract two or more algebraic fractions
- Convert an expression with linear factors in the denominator into partial fractions
- Divide algebraic expressions
- Convert an improper fraction into partial fraction form

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Common factors, factorise, numerator, denominator, reciprocal, partial fractions, linear factor, repeated factor, improper algebraic fraction, mixed fraction, algebraic division, remainder

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, Seeking additional support from your teachers at lunchtime drop in sessions, Searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.





Year 13 Mathematics – Algebraic Methods



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Year 13 Mathematics – Functions and Graphs



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Learning about this topic is important because:

Code breakers at Bletchley Park used inverse functions to decode enemy messages during World War II. When the enemy encoded a message they used a function. The code breakers' challenge was to find the inverse function that would decode the message.

This builds on: GCSE: Rearranging formulae, simplifying expressions, Y12: Sketching graphs and using functions

This leads to: Parametric Equations Y13

We will learn:

- Understand and use the modulus function
- Understand mappings and functions, and use domain and range
- Combine two or more functions to make a composite function
- Know how to find the inverse of a function graphically and algebraically
- Sketch the graphs of the modulus functions $y = |f(x)|$ and $y = f(|x|)$
- Apply a combination of two (or more) transformations to the same curve
- Transform the modulus function

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Modulus, magnitude, absolute value, mapping, function, one-to-one, many-to-one, composite function, inverse function, reflection, domain, range, translation, stretch, scale factor

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, Seeking additional support from your teachers at lunchtime drop in sessions, Searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.





Year 13 Mathematics – Functions and Graphs



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Year 13 Mathematics – Sequences and Series

Learning about this topic is important because:

Sequences and series can be found in nature, and can be used to model population growth or decline, or the spread of a virus.

This builds on: GCSE: Sequences and nth term, Y12: Exponentials and Logarithms

This leads to: Numerical Methods in Further Education

We will learn:

- Find the n th term of an arithmetic sequence
- Prove and use the formula for the sum of the first n terms of an arithmetic series
- Find the n th term of a geometric sequence
- Prove and use the formula for the sum to infinity of a convergent geometric sequence
- Use sigma notation to describe series
- Generate sequences from recurrence relations
- Model real-life situations with sequences and series

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Arithmetic sequence, consecutive, terms, common difference, sum, geometric, common ratio, series, convergent, divergent, sum to infinity, sigma, increasing sequence, decreasing sequence, periodic, order

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, Seeking additional support from your teachers at lunchtime drop in sessions, Searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.





Year 13 Mathematics – Sequences and Series



West Kirby
Grammar School

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Year 13 Mathematics – Binomial Expansion

Learning about this topic is important because:

The binomial expansion can be used to find polynomial approximations for expressions involving fractional or negative indices. Medical physicists use these approximations to analyse magnetic fields in an MRI scanner.

This builds on: Binomial Expansion Y12, Algebraic Expressions Y12

This leads to: Integration Y13

We will learn:

- Expand $(1 + x)^n$ for any rational constant n and determine the range of values of x for which the expansion is valid
- Expand $(a + bx)^n$ for any rational constant n and determine the range of values of x for which the expansion is valid
- Use partial fractions to expand fractional expressions

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Expansion, valid, expansion, approximation, modulus

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, Seeking additional support from your teachers at lunchtime drop in sessions, Searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.





Year 13 Mathematics – Binomial Expansion



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Year 13 Mathematics – Radians

Learning about this topic is important because:

Radians are units for measuring angles. They are used in mechanics to describe circular motion, and could be used, for example, to work out the distances between pods around the edge of a Ferris wheel.

This builds on: Y12 Trigonometry: Using identities, solving trigonometric equations

This leads to: Trigonometry and Modelling Y13

We will learn:

- Convert between degrees and radians and apply this to trigonometric graphs and their transformations
- Know exact values of angles measured in radians
- Find an arc length using radians
- Find areas of sectors and segments using radians
- Solve trigonometric equations in radians
- Use approximate trigonometric values when θ is small

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Radians, exact values, sine, cosine, tangent, acute, arc length, area, segment, sector, small angle

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, Seeking additional support from your teachers at lunchtime drop in sessions, Searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.





Year 13 Mathematics – Radians



West Kirby
Grammar School

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Year 13 Mathematics – Trigonometric Functions

Learning about this topic is important because:

Trigonometric functions can be used to model oscillations and resonance in bridges. You will use the functions in this topic as you perform differentiation, integration and work with vectors

This builds on: Y12 Trigonometric Identities and Equations, Y13 Radians

This leads to: Trigonometry and Modelling Y13

We will learn:

- Understand the definitions of secant, cosecant and cotangent and their relationship to cosine, sine and tangent
- Understand the graphs of secant, cosecant and cotangent and their domain and range
- Simplify expressions, prove simple identities and solve equations involving secant, cosecant and cotangent
- Prove and use $\sec^2 x \equiv 1 + \tan^2 x$ and $\operatorname{cosec}^2 x \equiv 1 + \cot^2 x$
- Understand and use inverse trigonometric functions and their domain and ranges

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Secant, Cosecant, Cotangent, Sine, Cosine, Tangent, Identities, Domain, Range, Period, Radians, Arcsine, arccosine, arctangent

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, Seeking additional support from your teachers at lunchtime drop in sessions, Searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.





Year 13 Mathematics – Trigonometric Functions



West Kirby
Grammar School

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Year 13 Mathematics – Trigonometry and Modelling

Learning about this topic is important because:

The strength of microwaves at different points within a microwave oven can be modelled using trigonometric functions.

This builds on: Y13 Radians, Y12 Trigonometric Identities and Equations, Y13 Trigonometric Functions

This leads to: Differentiation Y13, Integration Y13

We will learn:

- Prove and use the addition formulae
- Understand and use the double-angle formulae
- Solve trigonometric equations using the double-angle and addition formulae
- Write expressions of the form $a \cos \theta \pm b \sin \theta$ in the forms $R \cos(\theta \pm \alpha)$ or $R \sin(\theta \pm \alpha)$
- Prove trigonometric identities using a variety of identities
- Use trigonometric functions to model real-life situations

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Addition (Compound-angle) formulae, double-angled formulae, identities, equations, expressions

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, Seeking additional support from your teachers at lunchtime drop in sessions, Searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.





Year 13 Mathematics – Trigonometry and Modelling



West Kirby
Grammar School

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Year 13 Mathematics – Parametric Equations

Learning about this topic is important because:

Parametric equations can be used to describe the path of a ski jumper from the point of leaving the ski ramp to the point of landing

This builds on: GCSE: Rearranging formulae, Y13 Trigonometry and Modelling, Y13 Functions and Graphs, Y12 Circles

This leads to: Maths, Engineering or Physics in Further Education

We will learn:

- Convert parametric equations into Cartesian form by substitution
- Convert parametric equations into Cartesian form using trigonometric identities
- Understand and use parametric equations of curves and sketch parametric curves
- Solve coordinate geometry problems involving parametric equations
- Use parametric equations in modelling in a variety of contexts
- Differentiate parametric equations
- Integrate parametric equations

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Curve, parametric, Cartesian, substitution, domain, range, two-dimensions, differentiate, chain rule, integration

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, Seeking additional support from your teachers at lunchtime drop in sessions, Searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.





Year 13 Mathematics – Parametric Equations



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Year 13 Mathematics – Differentiation

Learning about this topic is important because:

Differentiation and integration can help us solve many types of real-world problems. We use the derivative to determine the maximum and minimum values of particular functions (e.g. cost, strength, amount of material used in a building, profit, loss, etc.). Derivatives are met in many engineering and science problems, especially when modelling the behaviour of moving objects.

This builds on: Y12 Differentiation, Y13 Trigonometric Functions

This leads to: Integration Y13, Differential equations Y13

We will learn:

- Differentiate trigonometric functions
- Differentiate exponentials and logarithms
- Differentiate functions using the chain, product and quotient rules
- Differentiate functions which are defined implicitly
- Use the second derivative to describe the behaviour of a function

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Small angles, sine, cosine, chain rule, product rule, quotient rule, implicit, explicit, concave, convex, point of Inflection, increasing function, decreasing function

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, Seeking additional support from your teachers at lunchtime drop in sessions, Searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.





Year 13 Mathematics – Differentiation



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Year 13 Mathematics – Numerical Methods



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Learning about this topic is important because:

Numerical methods are algorithms used for computing numeric data. They are used to provide 'approximate' results for the problems being dealt with and their necessity is felt when it becomes impossible or extremely difficult to solve a given problem algebraically. You can use numerical methods to find solutions to equations that are hard or impossible to solve exactly. The Newton-Raphson method was developed 400 years ago to describe the positions of planets as they orbit the sun.

This builds on: GCSE: Using functions, Y12 Differentiation, Y13 Differentiation, Y13 Sequences and Series

This leads to: Further Education (Computing, Engineering, Physics and Mathematics)

We will learn:

- Locate roots of $f(x) = 0$ by considering changes of sign
- Use iteration to find an approximation to the root of the equation $f(x) = 0$
- Use the Newton-Raphson procedure to find approximations to the solutions of equations of the form $f(x) = 0$
- Use numerical methods to solve problems in context

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Function, continuous, interval, root, iterative method, approximation

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, Seeking additional support from your teachers at lunchtime drop in sessions, Searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.





Year 13 Mathematics – Numerical Methods



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Year 13 Mathematics – Integration

Learning about this topic is important because:

Integration can be used to solve differential equations. Archaeologists use differential equations to estimate the age of fossilised plants and animals.

This builds on: Y13 Differentiation, Y12 Integration, Y12 Algebraic Expressions

This leads to: Calculus in Further Education (Physics and Mathematics) and in Further Mathematics A-level

We will learn:

- Integrate standard mathematical functions including trigonometric and exponential functions and use the reverse of the chain rule to integrate functions of the form $f(ax + b)$
- Use trigonometric identities in integration
- Use the reverse of the chain rule to integrate more complex functions
- Integrate functions by making a substitution, using integration by parts and using partial fractions
- Use integration to find the area under a curve
- Use the trapezium rule to approximate the area under a curve
- Understanding that integration and the area under a curve, represents the limit of a sum of areas

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Trigonometric Identities, expressions, integrate, differentiate, constant of integration, integration by substitution, by parts, partial fractions, area, trapezium rule, limit of a sum

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, Seeking additional support from your teachers at lunchtime drop in sessions, Searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.





Year 13 Mathematics – Integration



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Grammar School

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Year 13 Mathematics – Differential Equations

Learning about this topic is important because:

You can use differentiation to find rates of change in trigonometric and exponential models. The velocity of a wrecking ball could be estimated by modelling its displacement then differentiating. In this continuation of differentiation, we will work with more complex mathematic relationships and expand our problem solving tool kit

This builds on: Y13 Differentiation, Y13 Integration

This leads to: Calculus in Further Education (Physics and Mathematics) and in Further Mathematics A-level

We will learn:

- Solve problems involving connected rates of change and construct simple differential equations
- Solve simple differential equations and model real-life situations with differential equations

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Rate of change, separating variables, differential equation, general solution, particular solution, boundary condition, modelling, proportional

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, Seeking additional support from your teachers at lunchtime drop in sessions, Searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.





Year 13 Mathematics – Differential Equations



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Grammar School

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Year 13 Mathematics – Vectors

Learning about this topic is important because:

You can use vectors to describe relative positions in three dimensions. This allows you to solve geometrical problems in three dimensions and determine properties of 3D solids.

This builds on: Y12 Vectors**This leads to:** Vectors in Y13 Further Mathematics, Further Education (Engineering, Physics and Mathematics)**We will learn:**

- Understand 3D Cartesian coordinates
- Use vectors in three dimensions
- Use vectors to solve geometric problems
- Model 3D motion in mechanics with vectors

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Distance, Unit vector, 3D, Angles, Coefficients, Cartesian

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, Seeking additional support from your teachers at lunchtime drop in sessions, Searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.





Year 13 Mathematics – Vectors

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