Programme of study for Year 13 Alevel 24-2025

Autumn (1st term)	Autumn (2nd term)	Spring (1st term)	Spring (2nd Term)	Summer (1st term)	Summer (2nd term)
Topic/Key Questions/ **Pure:** Re-teach: Binomial expansion; Radians; Trigonometric functions **Applied maths:** Mechanics: Moments; Forces and Friction	Topic / Big Question: **Pure:** Trigonometry and modelling; Parametric Equations; Differentiation **Applied maths:** Mechanics: Applications of forces; Projectiles .	Topic / Big Question: **Pure:** Numerical Methods; Integration and Vector **Applied maths:** Statistics: Conditional probability. Mechanics- Further Kinematics	Topic / Big Question: N/A	Topic / Big Question: N/A	Topic / Big Question: N/A
Skills (students should be able to do): Know the difference between an arithmetic and geometric sequence. Know the difference between a sequence and series. Recall and use the formulae for the nth term	**Skills** (students should be able to do): Prove and use the addition formulae. Understand and use the double-angle formulae. Solve trigonometric equations using the double angle and addition formulae.	**Skills** (students should be able to do): Carry out formal mathematical proofs. Locate roots of $f(x) = 0$ by considering changes of sign. Use iteration to find an approximation to the root of the equation $f(x) = 0$.	Skills (students should be able to do): N/A	Skills (students should be able to do): N/A	Skills (students should be able to do): N/A

and summations of arithmetic and geometric sequences and series. Generate sequences using recurrence relations. Model real-life situations with sequences and series. Carry out binomial expansions for any rational constant and determine the range of values for which the expansion is valid. Convert between degrees and 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 x is small. Understand the definitions of secant, cosecant, and cotangent and their relationship to cosine, sine and tangent.	Simplify expressions of the form acosx + bsinx . Prove trigonometric identities using a variety of identities. Use trigonometric functions to model real-life situations. Convert parametric equations into Cartesian form by substitution and by 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 trigonometric functions. Differentiate exponentials and logarithms. Differentiate functions using the chain, product and quotient rules.	Use the Newton-Raphson method Applications to be modelling. 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. Use 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. Use vectors in 3D Use vectors to solve geometric problems Model 3D motion in mechanics with vectors.			

Simplify expressions, prove simple identities and solve equations using secant, cosecant, and cotangent. Calculate the turning effect of a force applied to a rigid body. Calculate the resultant moment of a set of forces acting on a rigid body. Solve problems involving uniform rods in equilibrium. Solve problems involving non-uniform rods. Solve problems involving rods on the point of tilting. Resolve forces into components Use the triangle law to find a resultant force Solve problems involving smooth or rough inclined planes Understand friction and the coefficient of friction	Differentiate functions which are defined implicitly. Use the second derivative to describe the behaviour of a function. Find an unknown force when a system is in equilibrium. Solve statics problems involving weight, tension and pulleys. Understand and solve problems involving limiting equilibrium. Solve problems involving motion on rough or smooth inclined planes. Solve problems involving connected particles that require the resolution of forces. Model motion under gravity for an object projected horizontally. Resolve velocity into components. Understand exponential models in bivariate data.	Understand set notation in probability. Understand conditional probability. Solve conditional probability problems using two-way tables and Venn diagrams. Use probability formulae to solve problems. Solve conditional probability using tree diagrams. Work with vectors for displacement, velocity and acceleration when using the vector equation of motion. Use calculus with harder functions of time involving variable acceleration. Differentiate and integrate vectors with respect to time.			

	Use a change of variable to estimate coefficients in an exponential model. Understand and calculate the product moment correlation coefficient. Carry out a hypothesis test for zero correlation Key Skills. – Mechanics: Work with vectors for displacement, velocity and acceleration when using the vector equation of motion. Use calculus with harder functions of time involving variable acceleration. Differentiate and integrate vectors with respect to time. Use iteration to find an approximation to the root of the equation f(x) = 0 Use the Newton-Raphson method Applications to be modelling. -Statistics: Understand set notation in probability. Understand conditional probability. Solve conditional probability problems using				

	two-way tables and Venn diagrams. Use probability formulae to solve problems. Solve conditional probability using tree diagrams. Understand the normal distribution and the characteristics of a normal distribution curve. Find percentage points and calculate values on a standard normal curve. Find unknown means and / or standard deviations for a normal distribution. Approximate a binomial distribution using a normal distribution. Select appropriate distributions and solve real-life problems in context. Solve problems involving particles projected at an angle. Derive the formulae for time of flight, range and greatest height, and the				

	equation of the path of a projectile.				
Key Learning Outcomes (students should know): By the end of the sub-unit, students will be able to perform all the skills highlighted above	Key Learning Outcomes (students should know): By the end of the sub-unit, students will be able to perform all the skills highlighted above	Key Learning Outcomes (Students should know): By the end of the sub-unit, students will be able to perform all the skills highlighted below.	Key Learning Outcomes (students should know):	Key Learning Outcomes (students should know):	Key Learning Outcomes (students should know):
End of term 1 assessment to cover: At the beginning of Spring 1, all year 13 pupils will be doing **their Mocks.** They will be tested on the following: Pure: All contents of AS in addition to Sequences and Series, Binomial expansion; Radians; Trigonometric functions Trigonometry and modelling; Parametric Equations; Differentiation. Applied: All contents of applied plus Moments; Forces and Friction, Applications of forces; Projectiles Formative assessment as per Assessment calendar		**End of term 2 assessment to cover:** At the beginning of summer 1 term, we desire to do a **final Mock Examination** that will be covering **all topics** from the Pure and from the Applied sections of the specification. Formative assessment as per Assessment calendar		**End of year assessment to cover:** **Exam practice –Past papers** Formative assessment as per Assessment calendar **Pupils will be sitting the Public Examination**	

Building understanding: Rationale / breakdown for your sequence of lessons: Sequences and Series will be retaught, anticipating that there will be those who would have missed the opportunity to have attended the prescribed lessons in year 12 Summer 2. This will also give rise to further strengthening the bases of the pupils who would have seen it all prior to now. Doing Radians at this point will lead to a greater appreciation of trigonometrical differentiation as it is the substratum of the basic differentials on which all others are built. Doing a more advanced form of trigonometry at this point will give pupils a continuous platform to build on the concepts that they would have seen in year 12. This will be more meaningful to them as they will be able to make the needed connections	**Building understanding: Rationale / breakdown for your sequence of lessons**: In terms of the trigonometric graphs and their solutions, the modelling of situation allows for the pupils to put into practice the content that they would have seen in the previous term as well as undergirding the AS concepts they saw. In kinematics this can then be extended to the waves themselves and the sporting context to surfing and other examples. The extensive use of graphs throughout this topic is vital to gaining an understanding of what is going on. However, there are other ways to set this process into context. The work on connected rates of change should all be set into practical	**Building understanding: Rationale / breakdown for your sequence of lessons:** Much of mechanics at a higher level and engineering at university relies on the ability to solve differential equations in some form or another. This is touched upon at a basic level here, however once again it is important for learners to know what is that they can achieve in the long term were they to pursue this further. Numerical Methods links with polynomials and finding roots using algebraic methods; curve sketching; number sets and irrational numbers. It is also related to limits, derivatives, recurrence relations, integrals and sequences. The idea of iteration is conceptually important and links well	**Building understanding: Rationale / breakdown for your sequence of lessons:** N/A	**Building understanding: Rationale / breakdown for your sequence of lessons:** N/A	**Building understanding: Rationale / breakdown for your sequence of lessons:** N/A

with little noise barriers to the Teaching and learning process.	contexts so that this too becomes a practical based topic rather than purely symbolic manipulation. However, it is often here that learners can find a difficulty because each type of question is slightly different and there is no “magic formula” to solve them. A carefully built understanding of the format of this section should help to overcome this. Lastly, constructing differential equations for a variety of scenarios again should be approached practically. This then provides a neat way to lead into the necessity for integration in order to solve these practical problems. Mechanics- Learners will be familiar with equilibrium problems if the object in question has no *size*. If the object has size, then equilibrium of moments also must be considered.	with arithmetic and geometric sequences. The philosophical ideas underlying upper and lower bounds would be interesting to discuss and would have long term benefits for mathematics students. Investigating and developing a good understanding of the fixed-point process would also be beneficial. Stationary points and gradients play a part in numerical methods and will allow teachers to revisit these ideas, and this will help to link these abstract areas together more. Numerical methods link very well with the idea of mathematical modelling on which a greater emphasis is now placed. Subject areas which link naturally with numerical methods include work on polynomial curves, their behaviour and shape and finding their roots. Curve sketching is also extremely			

	Recapping and making the needed link with the contents that they previous did will help learners develop the strategy of needing two equations for each situation; equilibria of forces and equilibria of moments. Finally, once they are familiar with this strategy more complex problems involving forces at angles can be attempted. There is a clear link with the previous work on Newton's First Law and Applications of vectors in a plane. This topic extends the learners knowledge of these concepts and tests their ability to draw clear diagrams, resolve forces and apply conditions of equilibria to rigid body problems. For extension, learners could use these methods in conjunction with the Laws of Friction to solve sliding and toppling problems. Calculus – The initial work on gradients and the	relevant with the idea of an asymptote and gaps in some curves playing an important role. This would be good as the pupils are facilitated to draw on all that they would have previously saw in previous chapters. Finding integrals of curves and, also the area beneath curves is linked with numerical methods. In fact, there is also common ground shared with the study of inequalities, recurrence relations, the modulus function, gradients and tangents, mechanics, statistics and decision mathematics. Vectors is taught at this instance as it is clearly the application to Mechanics – all forces are vectors. Pupils will then be facilitated to make the link and as such cause them to make a more meaningful appreciation of what they would have seen prior to this stage.			

	whole understanding of the nature of rate of change and gradient is essential to being able to apply this to the curve of Subsequent work on calculus will make use of natural logarithms so this section forms an important foundation for future study.	Similarly, for most of the equations of motion, displacement, velocity and acceleration are all vectors; though this is not always made explicit when dealing with motion in a straight line.			
Home – Learning: Mixed exercise questions e-platform "Integral"	Home – Learning: Mixed exercise questions e-platform "Integral"	Home – Learning: Mixed exercise questions e-platform "Integral"	Home – Learning: Topic unit tests e-platform "Integral"	Home – Learning: Topic unit tests Past exam papers	Home – Learning: Past exam papers
Reading / High Quality Text: Modelling type questions	Reading / High Quality Text: Modelling type questions	Reading / High Quality Text: Modelling type questions	Reading / High Quality Text: Modelling type questions	Reading / High Quality Text: Modelling type questions	Reading / High Quality Text: Modelling type questions
Numeracy:	Numeracy:	Numeracy:	Numeracy:	Numeracy:	Numeracy:

Enrichment / opportunities to develop cultural capital (including careers, WRL and SMSC):

Binomial Expansion: Medical physics applications of binomial expansion; trigonometric graphs modelling microwaves and other electromagnetic waves; engineering - moments used for calculations to do with use of cranes.

Regression, Correlation and Hypothesis Testing: Ice-cream sellers typically find that they sell more ice-cream the hotter day. You can measure the strength this correlation using product moment correlation coefficient.

Functions and graphs: 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.

Radians: Radians are units for measuring angles. They are used in mechanics to describe circular motion and can be used to work out the distance between the pods around the edges of a wheel.

Moments: Moments measure the turning effect of a force. Engineers use moments to work out how much load can be applied safely to a crane.

Sequence and Series: It can be found in nature and can be used to model population growth or decline, or the spread of the virus. A good example of this is Population of Southall grew by 21.3% since 2002 and population average age increased by 1 years in the same period.

Vectors: In computer graphics, vectors are used to represent positions, directions, and transformations in a 2D, or 3D space. For example, the position of a point in space or the direction of a light source can be represented using vectors. Moreover, they are used in navigation systems, such as GPS, to represent the direction and distance between two points on the Earth's surface. This helps in determining routes, distances, and locations accurately.

Numerical Methods: It can be used to describe the position of planets as they orbit the sun.

Integration: Archeoelogists use differential equations to estimate the age of fossilised plants and animals.

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

Projectiles: We can use projectile motion to model the flight of a basketball.

Application of forces: A tightrope walker uses a mathematical model to calculate the tension in his wire. This allows him to make sure that the wire is strong enough to hold his weight safely.

Differentiation: We can use differentiation to find the rates of change.

Integration: Archaeologists use differential equations to estimate the age of fossilised plants and animals.

Conditional Probability: The outcome of one event can affect the probability for another event. If a football team scores a goal, the probability that they will win the match will increase.

Normal distribution: In manufacturing and quality control processes, the normal distribution is frequently used to model variation in product specifications. Quality control charts, such as control charts for process monitoring, are based on the assumption of normality. In finance, asset returns are often assumed to be normally distributed. This assumption is used in portfolio theory, option pricing models like the Black-Scholes model, and risk management strategies. In medical research, the normal distribution is used to model characteristics such as blood pressure, cholesterol levels, and other biological measurements. It's also used in epidemiology to model the distribution of diseases in populations.