Year 12 Spring 1

Unit Overview: Straight Line Graphs, Circles, Algebraic Methods, Constant acceleration, Correlation, Probability								
Half- Term:	AUT 1	AUT 2	SPR 1	SPR 2	SUM 1	SUM 2	**No of Lessons:**	**30**

Key Focus for Unit:

What is the key knowledge being delivered? What is the intent of this unit?

Pure Maths

Binomial Expansion

- Understand the structure of Pascal's triangle and the link to binomial coefficients
- Use Pascal's triangle to expand simple binomial expressions
- Understand factorial and combination notation linked to Pascal's triangle
- Formulate relationships between binomial coefficients
- Understand and use the general binomial expansion for positive integer n
- Use the binomial expansion to find arbitrary terms for positive integer n
- Find approximations using the binomial expansion for positive integer n
- Solve problems using the binomial expansion (for positive integer n) in unfamiliar contexts (including the link to binomial probabilities)

Differentiation

- Understand the principle of gradients when applied to curves
- Understand the definition of derivative and the associated notation
- Understand dy/dx as the rate of change of y with respect to x
- Understand the technique for differentiating from first principles
- Understand the rule for differentiating x^n
- Carry out differentiation of simple functions
- Understand the notation for the second derivative and be able to find it
- Understand the second derivative as the rate of change of gradient
- Carry out differentiation from first principles rigorously to find the derivative of a given function (for small positive powers of x)
- Differentiate more complicated functions such as ones requiring initial simplification or rearrangement
- Evaluate the gradient of functions at specified points
- Solve coordinate geometry problems involving tangents and normals using first derivatives
- Use derivatives to determine whether a function is increasing or decreasing in a given interval (including application to curve sketching)
- Use the derivative to determine the location of stationary points
- Use the second derivative to determine the nature of stationary points
- Sketch graphs of functions using maximum and minimum points
- Sketch graphs of the gradient function of curves
- Apply derivatives and the principle of rate of change to real-life contexts
- Solve real-life problems involving rates of change

Integration

- Understand integration as the reverse of differentiation
- Understand that a constant of integration is required for an indefinite integral
- Integrate simple functions of the form x^n (n not equal to -1)
- Integrate more complicated functions such as those requiring simplification or rearrangement
- Find the equation of a curve given the gradient function and a point on the curve
- Find definite integrals analytically
- Find the area under a curve using integration
- Find an area below the x-axis using integration (including an appreciation of the meaning of a negative definite integral)
- Solve problems involving areas under graphs using integration

Applied (Mechanics)

Forces and Motion

- Use and understand weight
- Draw force diagrams
- Calculate resultant forces in perpendicular directions
- Understand Newton's first law and the concept of equilibrium
- Solve equilibrium problems involving single particles in familiar contexts
- Calculate resultant forces using vectors

Applied (Statistics)

Hypothesis Testing 1

- Understand the language of hypothesis testing
- Understand that a sample is used to make inferences about a population
- Find critical values and critical regions for a binomial distribution
- Interpret critical values and critical regions in context

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Key Knowledge and Big Ideas:

*What **Powerful Knowledge** and **Big Ideas** are explored in this Unit?*

*How have these progressed from previous learning? What **gaps in knowledge** have you identified from **baselining** and how are these being closed?*

BIG IDEAS:

Binomial Expansion, Differentiation, Integration, Forces and Motion, Hypothesis Testing

Powerful Knowledge:

- Formulate relationships between binomial coefficients
- Understand and use the general binomial expansion for positive integer n
- Use the binomial expansion to find arbitrary terms for positive integer n
- Find approximations using the binomial expansion for positive integer n
- Solve problems using the binomial expansion (for positive integer n) in unfamiliar contexts (including the link to binomial probabilities)
- Carry out differentiation from first principles rigorously to find the derivative of a given function (for small positive powers of x)
- Differentiate more complicated functions such as ones requiring initial simplification or rearrangement
- Evaluate the gradient of functions at specified points
- Solve coordinate geometry problems involving tangents and normals using first derivatives
- Use derivatives to determine whether a function is increasing or decreasing in a given interval (including application to curve sketching)
- Use the derivative to determine the location of stationary points
- Use the second derivative to determine the nature of stationary points
- Integrate more complicated functions such as those requiring simplification or rearrangement
- Find the equation of a curve given the gradient function and a point on the curve
- Find definite integrals analytically
- Find the area under a curve using integration
- Find an area below the x-axis using integration (including an appreciation of the meaning of a negative definite integral)
- Solve equilibrium problems involving single particles in familiar contexts
- Calculate resultant forces using vectors
- Find critical values and critical regions for a binomial distribution
- Interpret critical values and critical regions in context

Previous Learning:

- Straight Line Graphs
- Circles
- Algebraic Methods
- Constant acceleration
- Correlation
- Probability

Gaps in Knowledge and Misconceptions:

Contact forces between surfaces

- Students are often less knowledgeable about contact forces, that is, forces that occur when two bodies touch and their surfaces press on one another. This contact force always has a component at right angles to the surfaces, called the normal reaction. If there is a tendency for the two surfaces to move relative to each other, or if they actually do move, there is also a component of the contact force along the direction of the surfaces, usually called the resistance or resistive force. If the surface contact is smooth, then the resistive force is zero.
- Explain that, if both these components (normal reaction and resistance) exist, they can be combined using Pythagoras' Theorem and their resultant is called the 'total reaction' between the two objects, but this is not often done - exam questions usually prefer to keep the components separate.

Tensions and thrusts

- Students can confuse these two types of force. Have them imagine an object at rest on an icy surface. If a string is fixed to it and the string pulled, the object would move across the ice because of the force in the string. If the string could feel this happening, it would feel that it was being stretched, so the force in it is a tension.

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- However, the object on ice could be moved instead by having a rod pushing it from behind. If the rod could feel what was happening, it would feel it was being squashed by the object. The rod is thrusting the obiect forward - the force is a thrust.

Resolving a force

- Students may not fully understand what it means to 'resolve' a force. If you resolve a force, you find its component in a particular direction. You often find two components of a force at right-angles to each other, in which case you have resolved in two directions.

Unit Assessment:

How will this unit be assessed?

What is the frequency of assessments – baselines etc?

How we will assess

- Students will be assessed at the end of each chapter using past exam questions. These assessments will be cumulative so the chapter 5 assessment will test content from Chapter 1 and so on.

Key Retrieval Topics (Interleaving):

- Revise basic expansions of binomial expressions
- Revise basic binomial expansions
- Revise the concepts of percentage error
- Revise forming equations to solve contextual problems
- Revise the concept of gradients of straight lines
- Revise the principle of gradients
- Connect with rates of change when x represents time
- Revise the concept of gradient when applied to curves
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- Revise the general concept of differentiation to find the gradient function
- Revise the rule for differentiation of simple functions
- Revise differentiation of simple functions
- Revise the small-angle approximations for sinx and cosx
- Relate different gradient values to a graph
- Revise the concepts of perpendicular lines
- Revise the concept of a stationary point
- Revise graph sketching

Key Skills Explored	**Vocabulary Selected for DVI**	**Links to Previous Unit**
Pure • Binomial Expansion • Differentiation • Integration Applied (Mechanics) • Forces and Motion Applied (Statistics) • Hypothesis Testing	• Binomial • Differentiate • Integrate • Resultant Force • Equilibrium • Hypothesis • Critical Values/Regions	• The units covered in Spring 1 builds on the work students covered in Autumn 1 and 2

Links to Careers/Employability	**How does this unit prepare students for the next unit?**
• Teaching • Engineering • Accounting • Banking • Architecture	• Trigonometric ratios • Trigonometric identities and equations • Force and motion • Correlation