

Edexcel Level 3 Advanced GCE in Mathematics (9MA0)

Year 1 Scheme of Work

Term Time		WK NO.	W/C	Pure	Statistics	Mechanics
AUTUMN TERM 2015	TERM1 PART1			Algebra and Functions	Statistical Sampling Data presentation and interpretation	Quantities and units in mechanics
		1	06-Sep	Algebraic expressions- basic algebraic manipulation, indices and surds	Introduction to sampling terminology; Advantages and disadvantages of sampling Understand and use sampling techniques; Compare sampling techniques in context	
		2	11-Sep	Quadratic functions – factorising, solving, graphs and the discriminants	Calculation and interpretation of measures of location; Calculation and interpretation of measures of variation; Understand and use coding	
		3	18-Sep	Equations – quadratic/linear simultaneous		
		4	25-Sep	Inequalities – linear and quadratic (including graphical solutions)		
		5	02-Oct	Graphs – cubic, quartic and reciprocal		Introduction to mathematical modelling and standard S.I. units of length, time and mass
		6	09-Oct	Transformations – transforming graphs – $f(x)$ notation		Definitions of force, velocity, speed, acceleration and weight and displacement; Vector and scalar quantities

		7	16-Oct			
				Coordinate geometry in the (x,y) plane Further algebra	Data presentation and interpretation	Kinematics
	TERM 1 PART 2	1	30-Oct	Straight-line graphs, parallel/perpendicular, length and area problems	Interpret diagrams for single-variable data; Interpret scatter diagrams and regression lines; Recognise and interpret outliers; Draw simple conclusions from statistical problems	
		2	06-Nov	Circles – equation of a circle, geometric problems on a grid		
		3	13-Nov			
		4	20-Nov	Algebraic division, factor theorem and proof		Graphical representation of velocity, acceleration and displacement
		5	27-Nov			
		6	04-Dec	The binomial expansion		Motion in a straight line under constant acceleration; suvat formulae for constant acceleration; Vertical motion under gravity
		7	11-Dec			
		8	18-Dec			
				Trigonometry Vectors (2D)	Probability Statistical distributions	Forces & Newtons Laws
SPRING TERM 2016	TERM2 PART1	1	03-Jan	Trigonometric ratios and graphs (6 hours)	Probability: Mutually exclusive events; Independent events (3 hours)	
		2	08-Jan		Statistical distributions: Use discrete distributions to model real-world situations; Identify	

		3	15-Jan	Trigonometric identities and equations (10 hours)	the discrete uniform distribution; Calculate probabilities using the binomial distribution (calculator use expected) (5 hours)		
		4	22-Jan				
		5	29-Jan	Definitions, magnitude/direction, addition and scalar multiplication		Newton's first law, force diagrams, equilibrium, introduction to i, j system (4 hours)	
		6	05-Feb				
			7	12-Feb	Position vectors, distance between two points, geometric problems		
		TERM2 PART2			Differentiation Integration	Statistical hypothesis testing	Forces & Newton's laws
			1	26-Feb	Definition, differentiating polynomials, second derivatives (6 hours)	Language of hypothesis testing; Significance levels (2 hours)	
			2	05-Mar			
			3	12-Mar	Gradients, tangents, normals, maxima and minima (6 hours)	Carry out hypothesis tests involving the binomial distribution (5 hours)	
			4	19-Mar	Definition as opposite of differentiation, indefinite integrals of x^n		
			5	26-Mar			Newton's second law, 'F = ma', connected particles (no resolving forces or use of $F = \mu R$); Newton's third law: equilibrium, problems involving smooth pulleys (6 hours)
	SUMMER TERM 2016		6	03-Apr	Definite integrals and areas under curves (5 hours)		
					Exponentials and logarithms	Statistical Hypothesis testing	Kinematics 2 (variable acceleration)
		TERM 3 PART1	1	17-Apr		Language of hypothesis testing; Significance levels	

		2	23-Apr	Exponentials and logarithms: Exponential functions and natural logarithms	Revision	Carry out hypothesis tests involving the binomial distribution
		3	30-Apr		Revision	
		4	07-May	Revision	Revision	Variable force; Calculus to determine rates of change for kinematics
		5	14-May	Revision		
		6	21-May	Revision	Revision	Use of integration for kinematics problems i.e. $r = \int v dt$, $v = \int a dt$
	TERM3 PART2	1	04-Jun	Revision	Revision	Revision
		2	11-Jun	Revision	Revision	Revision
		3	18-Jun	Revision	Revision	Revision
		4	25-Jun	Revision	Revision	Revision
		5	02-Jul	Revision	Revision	Revision
6		09-Jul	Revision	Revision	Revision	
7		16-Jul	Revision	Revision	Revision	

Detailed Content Plan

- Chapters 1 – 11 cover the **pure mathematics content** that is tested on AS paper 1 / A-level papers 1 & 2.
- Chapters 12 – 14 cover the **statistics content** that is tested on AS paper 2 / A-level paper 3.
- Chapters 15 – 16 cover the **mechanics content** that is tested on AS paper 2 / A-level paper 3.

This scheme of work is designed to accompany the use of Collins' **Edexcel A-level Mathematics Year 1 and AS Student Book**, and references to sections in that book are given for each lesson.

KEY

Ex – exercise

DS – Data set activity (Statistics chapters only)

notation when solve problems involving combinations.				
<p>3 The binomial expansion</p> <p>Students are introduced to the binomial expansion formula as a way of solving any binomial expansion, they should state which formula they are using at the start of any answer.</p>	<ul style="list-style-type: none"> Understand and use the binomial expansion of $(a + b)^n$ 	<p>AS Paper 1/A-level Papers 1 & 2: 2.6 – manipulate polynomials algebraically 4.1 – binomial expansion</p>	<p>The binomial expansion is used in Chapter 13 Probability and statistical distributions for binomial distributions</p>	<p>1.3 Ex 1.3A</p>
<p>4 Factorisation</p> <p>Students factorise different sorts of expressions including quadratics. They also factorise a difference of two squares. Some questions are given in relation to real life problems to show how factorisation is used.</p>	<ul style="list-style-type: none"> Manipulate polynomials algebraically including: <ul style="list-style-type: none"> factorisation 	<p>AS Paper 1/A-level Papers 1 & 2: 2.6 – manipulate polynomials algebraically</p>	<p>Factorisation is used in Chapter 2 Algebra and functions 2: Equations and inequalities when working with quadratic equations and in Chapter 3 Algebra and functions 3: Sketching curves</p>	<p>1.4 Ex 1.4A</p>
<p>5 Algebraic division</p> <p>All the skills are then combined to write algebraic fractions in their simplest form. Students work through the factor theorem. Students then divide polynomials by an expression – make it clear to students that they use the same method as they do for numerical long division.</p>	<ul style="list-style-type: none"> Manipulate polynomials algebraically including: <ul style="list-style-type: none"> expanding brackets and simplifying by collecting like terms factorisation simple algebraic division use of the factor theorem 	<p>AS Paper 1/A-level Papers 1 & 2: 2.6 – manipulate polynomials algebraically, including expanding brackets, collecting like terms, factorisation and simple algebraic division; use of the factor theorem</p>	<p>Link algebraic division to numerical division</p>	<p>1.5 Ex 1.5A</p>
<p>6 Laws of indices, manipulating surds</p> <p>Students solve questions using the laws of indices, including negative and fractional</p>	<ul style="list-style-type: none"> Understand and use the laws of indices for all rational exponents Use and manipulate surds 	<p>AS Paper 1/A-level Papers 1 & 2: 1.1 – mathematical proof</p>	<p>Builds on GCSE skills Laws of indices is used in Chapter 7 Exponentials and logarithms, section 7.2</p>	<p>1.6 1.7 Ex 1.6A Ex 1.7A</p>

indexes. They are reminded that surds are roots of rational numbers and simplify expressions involving surds.		2.1 – understand and use the laws of indices for all rational exponents 2.2 - use and manipulate surds, including rationalising the denominator	Manipulation of indices and surds is used in Chapter 8 Differentiation and Chapter 9 Integration	
7 Rationalising the denominator Recap manipulating surds and complete Ex 1.7A if required and then students go on to rationalise the denominator of algebraic fractions.	<ul style="list-style-type: none"> Use and manipulate surds, including rationalising the denominator 	AS Paper 1/A-level Papers 1 & 2: 1.1 – mathematical proof 2.2 - use and manipulate surds, including rationalising the denominator		1.8 Ex 1.8A
8 Chapter review lesson Recap key points of chapter. Students to complete the exam-style questions, extension questions, or online end-of-chapter test	<ul style="list-style-type: none"> Identify areas of strength and development within the content of the chapter 			See below
Assessment Exam-style questions 1 in Student Book Exam-style extension questions 1 in Student Book End-of-chapter test 1 on Collins Connect				

CHAPTER 2 – Algebra and functions 2: Equations and inequalities (8 Hours)				
Prior knowledge needed Chapter 1				
Technology Use a calculator to check solutions to quadratic equations that have been solved by hand. Use a graphing software to plot lines when solving simultaneous equations so that students can see that where the lines intersect is the solution. Use graphing software to show the solutions to quadratic inequalities.				
One hour lessons	Learning objectives	Specification content	Topic links	Student Book references

<p>1 Quadratic functions</p> <p>Students draw and work out key aspects of quadratic functions, they also work out equations of given quadratic graphs. Make students aware that the notation $f(x)$ may be used.</p> <p>Consider the difference between drawing and sketching.</p>	<ul style="list-style-type: none"> • Work with quadratic functions and their graphs 	<p>AS Paper 1/A-level Papers 1 & 2: 2.3 – work with quadratics functions and their graphs</p>	<p>Make connections back to factorising in 1.4 Factorisation</p>	<p>2.1 Ex 2.1A</p>
<p>2 The discriminant of a quadratic function</p> <p>Students are reminded that the discriminant is $b^2 - 4ac$ and that the value of the discriminant indicates what type of roots and number of solutions a quadratic has. Link this to how students will sketch quadratics in the next chapter. Students need to make sure they have a quadratic in the form $ax^2 + bx + c = 0$ before they calculate the discriminant.</p>	<ul style="list-style-type: none"> • Calculate and use the discriminant of a quadratic function, including the conditions for real and repeated roots 	<p>AS Paper 1/A-level Papers 1 & 2: 2.3 – work with the discriminant of a quadratic function, including the conditions for real and repeated roots</p>	<p>Links to 3.1 Sketching curves of quadratic functions</p>	<p>2.2 Ex 2.2A</p>
<p>3 Completing the square</p> <p>Students complete the square on the general expression of a quadratic. They go onto solving quadratic equations by completing the square.</p> <p>The general formula for solving a quadratic equation can be derived by completing the square on the general form $y = ax^2 + bx + c$ – this is question 6 in Ex 2.4A.</p>	<ul style="list-style-type: none"> • Complete the square 	<p>AS Paper 1/A-level Papers 1 & 2: 1.1 – mathematical proof 2.3 – complete the square</p>	<p>5.1 Equations of circles uses completing the square when solving problems involving circles Links to 3.1 sketching curves of quadratic functions</p>	<p>2.3 Ex 2.3A</p>

<p>4 Solving quadratic equations</p> <p>Students use factorisation, using the formula, completing the square and calculators to solve quadratic equations, they consider advantages and disadvantages of each method. It's important not to be seen as a discrete set of skills but providing different information about the same equation.</p>	<ul style="list-style-type: none"> • Solve quadratic equations using <ul style="list-style-type: none"> ○ completing the square ○ the formula ○ factorisation 	<p>AS Paper 1/A-level Papers 1 & 2: 1.1 – mathematical proof 2.3 – solve quadratic equations</p>	<p>The ability to find solutions will help you solve distance, speed and time problems in Chapter 15 Kinematics and in Chapter 6 Trigonometry and Chapter 7 Exponentials and logarithms Link to graph drawing, 3.1 Sketching curves of quadratic functions</p>	<p>2.4 Ex 2.4A</p>
<p>5 Solving simultaneous equations</p> <p>Students go through solving two linear simultaneous equations by elimination and then by substitution. They need to think about which is the best method and why.</p>	<ul style="list-style-type: none"> • Solve simultaneous equations in two variables by <ul style="list-style-type: none"> ○ elimination or ○ by substitution, including one linear and one quadratic equation 	<p>AS Paper 1/A-level Papers 1 & 2: 2.4 – solve simultaneous equations in two variables by elimination and by substitution, including one linear and one quadratic equation</p>	<p>This is used when finding points of intersection with circles and straight lines in Chapter 5 Coordinate geometry 2: Circles</p>	<p>2.5 Ex 2.5A Ex 2.5B</p>
<p>6 Solving linear and quadratic simultaneous equations</p> <p>Student solve linear and quadratic simultaneous equations considering which method is the most appropriate to use.</p>	<ul style="list-style-type: none"> • Solve simultaneous equations in two variables by <ul style="list-style-type: none"> ○ elimination or ○ by substitution, including one linear and one quadratic equation 	<p>AS Paper 1/A-level Papers 1 & 2: 2.4 – solve simultaneous equations in two variables by elimination and by substitution, including one linear and one quadratic equation</p>		<p>2.6 Ex 2.6A</p>
<p>7 Solving linear and quadratic inequalities</p> <p>Students solve inequalities, use set notation to list integer members of two or more combined inequalities and represent inequalities graphically. Strict inequalities are represented with a dotted line, inclusive inequalities are represented with a solid line.</p>	<ul style="list-style-type: none"> • Solve linear and quadratic inequalities in a single variable and interpret such inequalities graphically, including inequalities with brackets and fractions • Express solutions through correct use of 'and' and 'or', or through set notation 	<p>AS Paper 1/A-level Papers 1 & 2: 2.5 - solve linear and quadratic inequalities in a single variable and interpret such inequalities graphically, including inequalities with brackets and fractions 2.5 - express solutions through correct use of 'and' and 'or', or through set notation</p>	<p>This is used in Chapter 5 Coordinate geometry 2: Circles when solving problems involving equations of circles</p>	<p>2.7 Ex 2.7A 2.8 Ex 2.8A</p>

Link to solving equations, drawing graphs and looking at inequalities from the sketch of a graph.				
8 Chapter review lesson Recap key points of chapter. Students to complete the exam-style questions, extension questions, or online end-of-chapter test	<ul style="list-style-type: none"> Identify areas of strength and development within the content of the chapter 			See below
Assessment Exam-style questions 2 in Student Book Exam-style extension questions 2 in Student Book End-of-chapter test 2 on Collins Connect				

CHAPTER 3 – Algebra and functions 3: Sketching curves (9 Hours)				
Prior knowledge needed Chapter 2				
Technology Graphing software can be heavily used in this chapter; some examples are below. Use graphing software to check answers. Use graphing software to zoom into a point of inflection and see what happens to the gradient of the curve each side of the point of inflection. Use graphing software to compare how to graphs behave. Use graphing software to look at approximate coordinates of turning points.				
One hour lessons	Learning objectives	Specification content	Topic links	Student Book references
1 Sketching curves of quadratic functions Students sketch curves of quadratic equations and find quadratic equations from sketches knowing that a sketch shows the curve along with its key features. The key features being; maximum or minimum turning point and	<ul style="list-style-type: none"> Use and understand the graphs of functions Sketch curves defined by simple quadratic equations 	AS Paper 1/A-level Papers 1 & 2: 2.3 – work with quadratic functions and their graphs 2.7 – understand and use graphs of functions; sketch curves defined by simple equations	Builds on from Chapter 2 Algebra and functions 2: Equations and inequalities	3.1 Ex 3.1A

its coordinates, the roots with x intercept/s if appropriate, the y intercept.				
<p>2 Sketching curves of cubic functions</p> <p>Students consider how the cubic functions behaves as it tends to positive and negative infinity, this determines the shape of the curve. The coordinates of the axes intercepts and point of inflection are included on the graph. Students use this information to sketch curves of cubic functions.</p>	<ul style="list-style-type: none"> • Use and understand the graphs of functions • Sketch curves defined by simple cubic equations 	<p>AS Paper 1/A-level Papers 1 & 2: 2.7 - understand and use graphs of functions; sketch curves defined by simple equations 2.7 – interpret algebraic solutions of equations graphically</p>	<p>Builds on from Chapter 2 Algebra and functions 2: Equations and inequalities</p>	<p>3.2 Ex 3.2A Ex 3.2B</p>
<p>3 Sketching curves of quartic functions</p> <p>Students find turning points and points of intersection to sketch curves of quartic functions. They look at maximum and minimum turning points and then at the roots of the equation. A typical example of a quartic to be sketched is $y = x^2(2x - 1)^2$.</p>	<ul style="list-style-type: none"> • Use and understand the graphs of functions • Sketch curves defined by simple quartic equations • Interpret the algebraic solution of equations graphically 	<p>AS Paper 1/A-level Papers 1 & 2: 2.7 - understand and use graphs of functions; sketch curves defined by simple equations 2.7 – interpret algebraic solutions of equations graphically</p>	<p>Builds on from Chapter 2 Algebra and function 2: Equations and inequalities</p>	<p>3.3 Ex 3.3A Ex 3.3B</p>
<p>4 Sketching curves of reciprocal functions</p> <p>Students sketch graphs of reciprocals of linear $y = \frac{a}{x}$ and quadratic $y = \frac{a}{x^2}$ functions. They are introduced to the word discontinuity and know that this is a point where the value of x or y is not defined. They also are told that an asymptote is a straight line that a curve approaches but never meets, these should</p>	<ul style="list-style-type: none"> • Use and understand the graphs of functions • Sketch curves defined by simple reciprocals • Interpret the algebraic solution of equations graphically 	<p>AS Paper 1/A-level Papers 1 & 2: 2.7 - understand and use graphs of functions; sketch curves defined by simple equations including polynomials $y = \frac{a}{x}$ and $y = \frac{a}{x^2}$ (including their vertical and horizontal asymptotes)</p>	<p>Graph sketching skills are further developed in Chapter 7 Exponentials and logarithms</p>	<p>3.4 Ex 3.4A Ex 3.4B</p>

be clearly highlighted on the graph. They also give the points of interception on the axis.				
<p>5 Intersection points</p> <p>Students sketch more than one function on a graph to work out the intersection points of the functions and link this to solve an equation which includes these functions. They use the information they have learnt for the previous section in this exercise to solve these problems.</p>	<ul style="list-style-type: none"> Use intersection points of graphs to solve equations 	AS Paper 1/A-level Papers 1 & 2: 2.7 interpret algebraic solution of equations graphically; use intersection points of graphs to solve problems	Links back to 2.5 Solving simultaneous equations	3.5 Ex 3.5A
<p>6 Proportional relationships</p> <p>Students express the relationship between two variables using the proportion symbol and then find the equation between the two variables. They also recognise and use graphs that show proportion.</p>	<ul style="list-style-type: none"> Understand and use proportional relationships and their graphs 	AS Paper 1/A-level Papers 1 & 2: 2.7 – understand and use proportional relationships and their graphs	Links back to GCSE	3.6 Ex 3.6A
<p>7 Translations</p> <p>Students transform functions and sketch the resulting graphs using the two transformations identified in the learning objective.</p>	<ul style="list-style-type: none"> Understand the effects of simple transformations on the graphs of $y = f(x)$, including $y = f(x) + a$ and $y = f(x + a)$ 	AS Paper 1: 2.8 – effects of simple transformations including sketching associated graphs A-level Papers 1 & 2: 2.9 – effects of simple transformations including sketching associated graphs	Translations and stretches arise in 6.5 solving trigonometric equations	3.7 Ex 3.7A
<p>8 Stretches</p> <p>Students transform functions and sketch the resulting graphs using the two transformations identified in the learning objective.</p>	<ul style="list-style-type: none"> Understand the effects of simple transformations on the graphs of $y = f(x)$, including $y = af(x)$ and $y = f(ax)$. 	AS Paper 1: 2.8 – effects of simple transformations including sketching associated graphs# A-level Papers 1 & 2:	Translations and stretches arise in 6.5 solving trigonometric equations	3.8 Ex 3.8A

		2.9 – effects of simple transformations including sketching associated graphs		
9 Chapter review lesson Recap key points of chapter. Students to complete the exam-style questions, extension questions, or online end-of-chapter test	<ul style="list-style-type: none"> Identify areas of strength and development within the content of the chapter 			See below
Assessment Exam-style questions 3 in Student Book Exam-style extension questions 3 in Student Book End-of-chapter test 3 on Collins Connect				

CHAPTER 4 – Coordinate geometry 1: Equations of straight lines (5 Hours)				
Prior knowledge needed Chapter 1				
Technology Use graphing software to check answers. Use graphing software to investigate the location of the x-intercept as the gradient varies with both positive and negative and integer and fractional values. Use graphing software to find equations of lines that are parallel. Use graphing software to plot lines that intersect but are not perpendicular. What do the students notice about the products of their gradients?				
One hour lessons	Learning objectives	Specification content	Topic links	Student Book references
1 Straight line graphs – part 1 Students rearrange equations of straight lines to the form $ax + by + c = 0$ Students find the equation of a line given the gradient and a point on the line and solve problems using this.	<ul style="list-style-type: none"> Write the equation of a straight line in the form $ax + by + c = 0$ Find the equation of a straight line through one point with a given gradient using the formula $y - y_1 = m(x - x_1)$ 	AS Paper 1/A-level Papers 1 & 2: 3.1 – understand and use the equation of a straight line, including the forms $y - y_1 = m(x - x_1)$ and $ax + by + c = 0$	4.2 and 4.3 link to Chapter 15 Kinematics	4.1 Ex 4.1A 4.2 Ex 4.2A

<p>2 Straight line graphs – part 2</p> <p>Students find the gradient given two points on the line and solve problems using this.</p> <p>Given two points on a line students use the formula to find the equation of the straight line.</p>	<ul style="list-style-type: none"> Find the gradient of the straight line between two points Find the equation of a straight line using the formula $\frac{y-y_1}{y_2-y_1} = \frac{x-x_1}{x_2-x_1}$ 	<p>AS Paper 1/A-level Papers 1 & 2: 3.1 – understand and use the equation of a straight line, including the forms $y - y_1 = m(x - x_1)$ and $ax + by + c = 0$</p>	<p>Graph sketching skills are further developed in Chapter 7 Exponentials and logarithms</p>	<p>4.3 Ex 4.3A</p> <p>4.4 Ex 4.4A</p>
<p>3 Parallel and perpendicular lines</p> <p>Students use the facts about gradients of parallel and perpendicular straight lines to solve problems.</p>	<ul style="list-style-type: none"> Understand and use the gradient conditions for parallel lines Understand and use the gradient conditions for perpendicular lines 	<p>AS Paper 1/A-level Papers 1 & 2: 3.1 – gradient conditions for two straight lines to be parallel or perpendicular</p>	<p>Links back to GCSE</p>	<p>4.5 Ex 4.5A Ex 4.5B</p>
<p>4 Straight line models</p> <p>Students apply what they have learnt in this chapter to solve problems in a variety of different contexts including real-world scenarios.</p>	<ul style="list-style-type: none"> Be able to use straight line models in a variety of contexts 	<p>AS Paper 1/A-level Papers 1 & 2: 3.1 – be able to use straight line models in a variety of contexts</p>	<p>This is used in Chapter 5 Coordinate geometry 2: Circles when finding a gradient to solve problems involving tangents and radii of circles and points of intersections of circles with straight lines</p>	<p>4.6 Ex 4.6A</p>
<p>5 Chapter review lesson</p> <p>Recap key points of chapter. Students to complete the exam-style questions, extension questions, or online end-of-chapter test</p>	<ul style="list-style-type: none"> Identify areas of strength and development within the content of the chapter 			<p>See below</p>
<p>Assessment</p> <p>Exam-style questions 4 in Student Book Exam-style extension questions 4 in Student Book End-of-chapter test 4 on Collins Connect</p>				

CHAPTER 5 – Coordinate geometry 2: Circles (6 Hours)

Prior knowledge needed

Chapter 2

Chapter 4

Technology

Use graphing software draw $x^2 + y^2 = 25$ and $x^2 + y^2 = 36$ to show how the centre of a circle is always (0, 0) and the radius is the square root of the number on the right-hand side of the equation. Get students to predict what other circles will look like given an equation of a circle in this form.

Graphing software can be used to look at other circles (still with the equation written in this form but not with centre (0, 0)) and link the equation of the circle to the coordinates of the centre and length of radius.

Use graphing software to find midpoints of line segments.

Use graphing software to plot a circle and tangent.

One hour lessons	Learning objectives	Specification content	Topic links	Student Book references
<p>1 Equations of circles – part 1</p> <p>Students link equations of circles to Pythagoras’ theorem. They learn the general equation of a circle and solve problems. They find the equation of a circle from its centre and a point on the circumference. Given an equation of a circle students find the centre and radius by completing the square on x and y.</p>	<ul style="list-style-type: none"> Find the centre of the circle and the radius from the equation of a circle Write the equation of a circle 	<p>AS Paper 1/A-level Papers 1 & 2: 3.2 – understand and use the coordinate geometry of the circle including using the equation of a circle in the form $(x-a)^2 + (y-b)^2 = r^2$ 3.2 – complete the square to find the centre and radius of a circle</p>	<p>Links back to GCSE</p>	<p>5.1 Ex 5.1A</p>
<p>2 Equations of circles – part 2</p> <p>Recap lesson one and then students find the equation of a circle from the ends of a diameter, this involves them using the formula for the midpoint of a line segment.</p>	<ul style="list-style-type: none"> Find the centre of the circle and the radius from the equation of a circle Write the equation of a circle 	<p>AS Paper 1/A-level Papers 1 & 2: 3.2 – understand and use the coordinate geometry of the circle including using the equation of a circle in the form $(x-a)^2 + (y-b)^2 = r^2$ 3.2 – complete the square to find the centre and radius of a circle</p>		<p>5.1 Ex 5.1B</p>

<p>3 Angles in semicircles</p> <p>A geometric proof is used to show that for three points on the circumference of a circle, if two points are on a diameter, then the triangle is right-angled. Students are also reminded that Pythagoras' theorem will show that a triangle has a right angle and gradients can be used to show that two lines are perpendicular.</p>	<ul style="list-style-type: none"> • Find the equation of a circle given different information such as the end points of a diameter • Use circle theorems to solve problems 	<p>AS Paper 1/A-level Papers 1 & 2: 1.1 - mathematical proof 3.2 - use of the following properties: the angle in a semicircle is a right angle</p>	<p>Links back to GCSE</p>	<p>5.2 Ex 5.2A</p>
<p>4 Perpendicular from the centre to a chord</p> <p>A geometric proof is used to show that congruent triangles are identical and then links to show that the perpendicular from the centre of the circle to a chord bisects the chord.</p>	<ul style="list-style-type: none"> • Find the equation of a perpendicular bisector • Use circle theorems to solve problems 	<p>AS Paper 1/A-level Papers 1 & 2: 3.2 - use of the following properties: the perpendicular from the centre to a chord bisects to chord</p>	<p>Links back to GCSE</p>	<p>5.3 Ex 5.3A</p>
<p>5 Radius perpendicular to the tangent</p> <p>A geometric proof by contradiction is used to show that a radius and tangent are perpendicular at the point of contact. Pythagoras' theorem is used to find the length of a tangent. Students then go on to consider that for any circle there are two tangents with the same gradient. Given the gradient of the tangent and the equation of the circle they can find both points where the two tangents touch the circle. The second method used it to show that a line is tangent to a circle is that the discriminant will be zero i.e. $b^2 - 4ac = 0$.</p>	<ul style="list-style-type: none"> • Find the equation and length of a tangent • Use circle theorems to solve problems 	<p>AS Paper 1/A-level Papers 1 & 2: 3.2 - use of the following properties: the radius of a circle at a given point on its circumference is perpendicular to the tangent to the circle at that point</p>		<p>5.4 Ex 5.4A Ex 5.4B</p>

<p>6 Chapter review lesson</p> <p>Recap key points of chapter. Students to complete the exam-style questions, extension questions, or online end-of-chapter test</p>	<ul style="list-style-type: none"> Identify areas of strength and development within the content of the chapter 			See below
<p>Assessment</p> <p>Exam-style questions 5 in Student Book Exam-style extension questions 5 in Student Book End-of-chapter test 5 on Collins Connect</p>				

<p>CHAPTER 6 – Trigonometry (7 Hours)</p>				
<p>Prior knowledge needed</p> <p>Chapter 2 Chapter 3</p>				
<p>Technology</p> <p>Use calculators to check values. Use graphic software to confirm the shapes of graphs.</p>				
One hour lessons	Learning objectives	Specification content	Topic links	Student Book references
<p>1 Sine and cosine</p> <p>Students extend their knowledge of sine and cosine beyond 90° to between 0° and 180° by imagining a rod of length one unit on a coordinate grid.</p>	<ul style="list-style-type: none"> Define sine for any angle Define cosine for any angle 	<p>AS Paper 1/A-level Papers 1 & 2: 5.1 – understand and use the definitions of sine and cosine for all arguments</p>	<p>Links back to GCSE</p> <p>Bearings will be extended further in Chapter 10 Vectors</p>	<p>6.1 Ex 6.1A</p>
<p>2 The sine rule and the cosine rule</p> <p>Students work through proofs for the sine rule, cosine rule and formula for the area of a triangle and then use these to solve problems.</p>	<ul style="list-style-type: none"> Use the sine rule Use the cosine rule Use the formula for the area of a triangle 	<p>AS Paper 1/A-level Papers 1 & 2: 5.1 - the sine and cosine rule 5.1 – the area of a triangle in the form $\frac{1}{2}ab\sin C$</p>	<p>Links back to GCSE</p>	<p>6.2 Ex 6.2A</p>

<p>3 Trigonometric graphs</p> <p>Students start by considering the sine and cosine of any angle using x and y coordinates of points on the unit circle. This is then linked to the trigonometric graphs and their symmetries and periodicity.</p>	<ul style="list-style-type: none"> • Understand the graph of the sine function and interpret its symmetry and periodicity • Understand the graph of the cosine function and interpret its symmetry and periodicity 	<p>AS Paper 1: 5.2 – Understand and use the sine and cosine functions; their graphs, symmetries and periodicity</p> <p>A-level Papers 1 & 2: 5.3 – Understand and use the sine and cosine functions; their graphs, symmetries and periodicity</p>	<p>Link back to GCSE</p>	<p>6.3 Ex 6.3A</p>
<p>4 The tangent function</p> <p>Students consider when the tangent cannot be calculated and look at the similarities between the tangent graph and the sine and cosine graphs. They use $\tan\theta = \frac{\sin\theta}{\cos\theta}$ to solve problems.</p>	<ul style="list-style-type: none"> • Define the tangent for any angle • Understand the graph of the tangent function and interpret its symmetry and periodicity • Use an important formula connecting $\sin x$, $\cos x$ and $\tan x$ 	<p>AS Paper 1: 5.1 – understand and use the definition of tangent for all arguments 5.2 - Understand and use the tangent functions; its graph, symmetry and periodicity 5.3 – understand and use $\tan\theta = \frac{\sin\theta}{\cos\theta}$</p> <p>A-level Papers 1 & 2: 5.1 – understand and use the definition of tangent for all arguments 5.3 - Understand and use the tangent functions; its graph, symmetry and periodicity 5.5 – understand and use $\tan\theta = \frac{\sin\theta}{\cos\theta}$</p>	<p>Link to Chapter 4 Coordinate geometry 1: Equations of straight lines</p>	<p>6.4 Ex 6.4A</p>
<p>5 Solving trigonometric equations</p> <p>Students think about the multiple solutions of trigonometric equations and link this to the graphs of the function.</p>	<ul style="list-style-type: none"> • Solve simple trigonometric equations 	<p>AS Paper 1: 5.4 – solve simple trigonometric equations in a given interval, including quadratic equations in sin, cos and tan and equations involving multiples of the unknown angle</p>	<p>Link this back to transformation of graphs in Chapter 3 Algebra and functions 3</p>	<p>6.5 Ex 6.5A</p>

		A-level Papers 1 & 2: 5.7 – solve simple trigonometric equations in a given interval, including quadratic equations in sin, cos and tan and equations involving multiples of the unknown angle		
<p>6 A useful formula</p> <p>Students diagrammatically see that $\sin^2\theta + \cos^2\theta = 1$ and then use this identity to go on to solve trigonometric equations.</p> <p>Link to Pythagoras' theorem.</p>	<ul style="list-style-type: none"> Use an important formula connecting $\sin x$, $\cos x$ and $\tan x$ 	<p>AS Paper 1: 5.3 – understand and use $\sin^2\theta + \cos^2\theta = 1$</p> <p>A-level Papers 1 & 2: 5.5 – understand and use $\sin^2\theta + \cos^2\theta = 1$</p>	Link to Pythagoras' theorem.	6.6 Ex 6.6A
<p>7 Chapter review lesson</p> <p>Recap key points of chapter. Students to complete the exam-style questions, extension questions, or online end-of-chapter test</p>	<ul style="list-style-type: none"> Identify areas of strength and development within the content of the chapter 			See below
<p>Assessment Exam-style questions 6 in Student Book Exam-style extension questions 6 in Student Book End-of-chapter test 6 on Collins Connect</p>				

CHAPTER 7 – Exponentials and logarithms (8 Hours)

Prior knowledge needed

Chapter 1
Chapter 2

Chapter 3 Chapter 4				
Technology Graph plotting software to draw the graphs $y = 1.2^x$. Use the log, power of e and ln button on a calculator. Use spreadsheet software to calculate values of logarithms.				
One hour lessons	Learning objectives	Specification content	Topic links	Student Book references
<p>1 The function a^x</p> <p>Students learn the terms exponential growth and exponential decay. They draw graphs of the form $y = a^x$ and are made aware that there is a difference in the shape of the graph when $a < 1$ and $a > 1$, they should understand this.</p>	<ul style="list-style-type: none"> Use and manipulate expressions in the form $y = a^x$ where the variable x is an index Draw and interpret graphs of the form $y = a^x$ Use the graph to find approximate solutions 	<p>AS Paper 1/A-level Papers 1 & 2: 6.1 – Know and use the function a^x and its graph, where a is positive</p>	<p>Links back to GCSE</p>	<p>7.1 Ex 7.1A</p>
<p>2 Logarithms</p> <p>Students start with the laws of logarithms in base 10 and the laws of logarithms are linked to laws of indices with a proof for each law. They work out basic logarithms in base 10 without a calculator. They then move onto using the laws for logarithms of any base and using the \log_{ab} button on a calculator.</p>	<ul style="list-style-type: none"> Understand and use logarithms and their connection with indices Understand the proof of the laws of logarithms 	<p>AS Paper 1/A-level Papers 1 & 2: 6.3 – know and use the definition of $\log_a x$ as the inverse of a^x, where a is positive and $x \geq 0$ 6.4 – understand and use the laws of logarithms</p>	<p>The skills learnt in 1.6 Laws of indices are used here</p>	<p>7.2 Ex 7.2A Ex 7.2B</p>
<p>3 The equation $a^x = b$</p> <p>Students solve equations of the form $a^x = b$ by taking the logarithms of both sides. They work through a proof of the</p>	<ul style="list-style-type: none"> Solve equations in the form $a^x = b$ Understand a proof of the formula to change the base of a logarithm 	<p>AS Paper 1/A-level Papers 1 & 2: 6.5 – solve equations in the form $a^x = b$</p>		<p>7.3 Ex 7.3A</p>

<p>formula to change the base of a logarithm.</p>				
<p>4 Logarithmic graphs</p> <p>Students look at two different types of curve $y = ax^n$ and $y = kb^x$. To find the parameters they take the logarithms of both sides and then rearrange this equation into the form $y = mx + c$. In the first case they plot $\log y$ against $\log x$ and obtain a straight line where the intercept is $\log a$ and the gradient is n and in the second case they plot $\log y$ against x and obtain a straight line where the intercept is $\log k$ and the gradient is $\log b$.</p>	<ul style="list-style-type: none"> • Use and manipulate expressions in the form $y = ka^x$ where the variable x is an index • Use logarithmic graphs to estimate parameters in relationships of the form $y = ax^n$ and $y = kb^x$, given data for x and y 	<p>AS Paper 1/A-level Papers 1 & 2: 6.3 – know and use the definition of $\log ax$ as the inverse of a^x, where a is positive and $x \geq 0$ 6.6 – use logarithmic graphs to estimate parameters in relationships of the form $y = ax^n$ and $y = kb^x$, given data for x and y</p>		<p>7.4 Ex 7.4A</p>
<p>5 The number e</p> <p>Students look at graphs of the form $y = a^x$ and see the gradient is always a multiplier $x y$. When the multiplier is one then the function is of the form $y = e^x$ and go on to generalise that for $y = e^{ax}$ then the gradient = $ae^{ax} = ay$ for any value of a. Students should realise that when the rate of change is proportional to the y value, an exponential model should be used. Insure that students include the graphs of $y = e^{ax} + b + c$.</p>	<ul style="list-style-type: none"> • Know that the gradient of e^{kx} is equal to ke^{kx} and hence understand why the exponential model is suitable in many applications 	<p>AS Paper 1/A-level Papers 1 & 2: 6.1 – Know and use the function e^x and its graph 6.2 – Know that the gradient of e^{kx} is equal to ke^{kx} and hence understand why the exponential model is suitable in many applications</p>		<p>7.5 Ex 7.5A</p>
<p>6 Natural logarithms</p> <p>Students are introduced to the fact that $\ln y$ means logarithm to the base e and that if $e^x = y$ then $\ln y = x$. The graphs of</p>	<ul style="list-style-type: none"> • Know and use the function $\ln x$ and its graphs • Know and use $\ln x$ as the inverse function of e^x 	<p>AS Paper 1/A-level Papers 1 & 2: 6.3 – know and use the function $\ln x$ and its graph 6.3 – know and use $\ln x$ as the inverse function of e^x</p>		<p>7.6 Ex 7.6A</p>

<p>$y = \ln x$ and $y = e^x$ show students that they are a reflection of each other in the line $y = x$ due to the fact they are inverse function. Solutions of equations of the form $e^{ax+b} = p$ and $\ln(ax + b) = q$ is expected.</p>				
<p>7 Exponential growth and decay</p> <p>Equations of exponential growth and decay are often written in terms of powers of e as it makes it easy to find the rate of change at any time. Exponential growth and decay are often described by a relationship of the form $y = ae^{kx}$ where a and k are parameters. For growth $a > 0$ and for decay $a < 0$.</p>	<ul style="list-style-type: none"> Recognise and interpret exponential growth and decay in modelling change 	<p>AS Paper 1/A-level Papers 1 & 2: 6.7 – understand and use exponential growth and decay; use in modelling (examples may include the use of e in continuous compound interest, radioactive decay, drug concentration decay, exponential growth as a model for population growth); consideration of limitations and refinements of exponential models</p>		<p>7.7 Ex 7.7A</p>
<p>8 Chapter review lesson</p> <p>Recap key points of chapter. Students to complete the exam-style questions, extension questions, or online end-of-chapter test</p>	<ul style="list-style-type: none"> Identify areas of strength and development within the content of the chapter 			<p>See below</p>
<p>Assessment Exam-style questions 7 in Student Book Exam-style extension questions 7 in Student Book End-of-chapter test 7 on Collins Connect</p>				

<p>CHAPTER 8 – Differentiation (8 Hours)</p>
<p>Prior knowledge needed Chapter 1 Chapter 3 Chapter 4</p>

Technology				
Use graphical software to find the gradients of a quadratic curve in example 2 in section 8.2. Graphical software can be used to look for stationary points – students also need to find them using differentiation.				
One hour lessons	Learning objectives	Specification content	Topic links	Student Book references
<p>1 The gradient of a curve</p> <p>Students are introduced to the concept that the gradient of a curve at any point is equal to the gradient of the tangent at that point.</p> <p>Students then look at $y = x^2$ and see that the gradient at any point on the curve is $2x$. The derivative is then introduced as the connection between the x coordinate of a point and the gradient of the curve at that point.</p>	<ul style="list-style-type: none"> To consider the relationship between the tangent to a curve and the gradient of the curve at a point Introduction of the term derivative Recognise the derivative function of $y = x^2$ 	<p>AS Paper 1/A-level Papers 1 & 2: 7.1 – understand and use the derivative of $f(x)$ as the gradient of the tangent to a graph of $y = f(x)$ at a general point (x, y); the gradient of the tangent as a limit; interpretation as a rate of change</p>	<p>The skills learnt in this chapter are essential when students learn Chapter 9 Integration</p>	<p>8.1 Ex 8.1A</p> <p>8.2 Ex 8.2A</p>
<p>2 The gradient of a quadratic curve</p> <p>From exercise 8.2A students are lead to the general result that if $y = ax^2$ then $\frac{dy}{dx} = 2ax$. After some examples students are given the general result when differentiating a quadratic. It is also made clear that terms should be differentiated separately in a quadratic equation. They start to sketch curves of the derivative.</p>	<ul style="list-style-type: none"> Extend the result for the derivative of $y = x^2$ to the general case $y = ax^2$ Be able to differentiate any quadratic equation 	<p>AS Paper 1/A-level Papers 1 & 2: 7.1 – sketching the gradient function for a given curve 7.2 – differentiate x^n, for rational values of n, and related constant multiples, sums and differences</p>		<p>8.2 Ex 8.2B</p>
<p>3 Differentiation of x^2 and x^3</p> <p>Students work through a proof that the derivative of x^2 is $2x$, they are told that using the formula is called differentiation from first principles.</p>	<ul style="list-style-type: none"> Understand a proof that if $f(x) = x^2$ then $f'(x) = 2x$ 	<p>AS Paper 1/A-level Papers 1 & 2: 7.1 – differentiation from first principals for small positive integer powers of x 7.2 - differentiate x^n, for rational values of n, and related constant multiples, sums and differences</p>		<p>8.3 Ex 8.3A</p>

<p>4 Differentiation of a polynomial</p> <p>The general result for differentiation is introduced to students and examples are worked through. They then go on to looking at differentiating the sum or difference of terms.</p>	<ul style="list-style-type: none"> Differentiate expressions containing integer powers 	<p>AS Paper 1: A-level Papers 1 & 2: 7.2 - differentiate x^n, for rational values of n, and related constant multiples, sums and differences</p>		<p>8.4 Ex 8.4A</p>
<p>5 Differentiation of x^n</p> <p>Students move on to work with powers that are not integer values and variables other than x and y. Differentiation is again linked to being the gradient of the graph and the rate of change.</p>	<ul style="list-style-type: none"> Differentiate expressions containing powers of variables 	<p>AS Paper 1/ A-level Papers 1 & 2: 7.2 - differentiate x^n, for rational values of n, and related constant multiples, sums and differences</p>		<p>8.5 Ex 8.5A Ex 8.5B</p>
<p>6 Stationary points and the second derivative</p> <p>Differentiation is used to find stationary points, i.e. the point where $\frac{dy}{dx} = 0$. Students are shown that the second derivative will show if a turning point is a maximum or minimum point so there is no need to draw the graph to ascertain this information.</p>	<ul style="list-style-type: none"> Determine geometrical properties of a curve 	<p>AS Paper 1: A-level Papers 1 & 2: 7.1 – second derivatives 7.1 – understand and use the second derivative as the rate of change of gradient 7.3 – apply differentiation to find gradients, tangents and normal, maxima and minima and stationary points 7.3 – identify where functions are increasing and decreasing</p>		<p>8.6 Ex 8.6A</p>
<p>7 Tangents and normal</p> <p>The normal at any point on a curve is perpendicular to the tangent at that point. As the product of their gradients is -1 differentiation can be used to find the equations of the tangent and the normal.</p>	<ul style="list-style-type: none"> Find equations of tangents and normal using differentiation 	<p>AS Paper 1: A-level Papers 1 & 2: 7.3 – apply differentiation to find gradients, tangents and normal, maxima and minima and stationary points 7.3 – identify where functions are increasing and decreasing</p>		<p>8.7 Ex 8.7A</p>
<p>8 Chapter review lesson</p> <p>Recap key points of chapter. Students to complete the exam-style questions,</p>	<ul style="list-style-type: none"> Identify areas of strength and development within the content of the chapter 			<p>See below</p>

extension questions, or online end-of-chapter test				
Assessment Exam-style questions 8 in Student Book Exam-style extension questions 8 in Student Book End-of-chapter test 8 on Collins Connect				

CHAPTER 9 – Integration (5 Hours)				
Prior knowledge needed Chapter 1 Chapter 3 Chapter 8				
Technology Graphics calculators/software can be used to look at areas under a curve and model changes.				
One hour lessons	Learning objectives	Specification content	Topic links	Student Book references
1 Indefinite integrals Students look at integration being the reverse process of differentiation. Because the derivative of the final constant is zero the result of integration is sometimes called the indefinite integral because the value of c is not fixed. Students integrate the sum or difference of terms by integrating them separately.	<ul style="list-style-type: none"> Make use of the connections between differentiation and integration 	AS Paper 1/A-level Papers 1 & 2: 8.1 – Know and use the Fundamental Theorem of Calculus 8.2 – Integrate x^n (excluding $n = -1$), and related sums, differences and constant multiples	The fundamental theorem of calculus is used in 15.4 Displacement-time and velocity-time graphs	9.1 Ex 9.1A
2 Indefinite integrals continued Students move the learning from the first lesson forward by finding the equations of	<ul style="list-style-type: none"> Find the equation of a curve when you know the gradient and point on a curve 	AS Paper 1/A-level Papers 1 & 2: 8.1 – Know and use the Fundamental Theorem of Calculus 8.2 – Integrate x^n (excluding $n = -1$), and related sums, differences and constant multiples		9.1 Ex 9.1B

the curve given the derivative and a point on the curve				
3 The area under a curve Students move on to calculate definitive integrals and are introduced to the notation. This enables them to calculate the area under curves. Students complete the first 6 questions of exercise 9.2A	<ul style="list-style-type: none"> Use a technique called integration to find the area under a curve 	AS Paper 1/A-level Papers 1 & 2: 8.2 – Integrate x^n (excluding $n = -1$), and related sums, differences and constant multiples 8.3 – Evaluate definite integrals; use a definite integral to find the area under a curve		9.2 Ex 9.2A
4 The area under a curve continued Recap knowledge from this and the previous chapter (differentiation) ensuring students clearly understand the link between differentiation and integration. Students finish exercise 9.2A.	<ul style="list-style-type: none"> Use a technique called integration to find the area under a curve 	AS Paper 1/A-level Papers 1 & 2: 8.2 – Integrate x^n (excluding $n = -1$), and related sums, differences and constant multiples 8.3 – Evaluate definite integrals; use a definite integral to find the area under a curve		9.2 Ex 9.2A
5 Chapter review lesson Recap key points of chapter. Students to complete the exam-style questions, extension questions, or online end-of-chapter test	<ul style="list-style-type: none"> Identify areas of strength and development within the content of the chapter 			See below
Assessment Exam-style questions 9 in Student Book Exam-style extension questions 9 in Student Book End-of-chapter test 9 on Collins Connect				

Prior knowledge needed				
Chapter 6				
Technology				
Use a graphics package to plot vectors and investigate how the angle changes depending on the orientation. Plotting diagrams using graphics software enables you to visualise the situation and see how the vectors will still satisfy the rules even if the orientation of the vectors is not identical.				
One hour lessons	Learning objectives	Specification content	Topic links	Student Book references
<p>1 Definition of a vector</p> <p>Students look at vector notation and use Pythagoras' theorem to calculate the magnitude of vectors. They use trigonometry to find the direction of a vector or use bearings. They calculate the unit vector and use this to find a velocity vector.</p>	<ul style="list-style-type: none"> • Write a vector in $i j$ or as a column vector • Calculate the magnitude and direction of a vector as a bearing in two dimensions • Identify a unit vector and scale it up as appropriate • Find a velocity vector 	<p>AS Paper 1: 9.1 – use vectors in two dimensions 9.2 – calculate the magnitude and direction of a vector and convert between component form and magnitude/direction form</p> <p>A-level Papers 1 & 2: 10.1 – use vectors in two dimensions 10.2 – calculate the magnitude and direction of a vector and convert between component form and magnitude/direction form</p>	<p>Trigonometric bearings were introduced in 6.2 The sine rule and the cosine rule</p>	<p>10.1 Ex 10.1A</p>
<p>2 Adding vectors</p> <p>Students add and subtract vectors in both $i j$ and column notation. They are introduced to the three types of vectors (equal, opposite and parallel) and learn that parallel vectors contain a common factor.</p>	<ul style="list-style-type: none"> • Add vectors • Multiply a vector by a scalar 	<p>AS Paper 1: 9.3 – add vectors diagrammatically and perform the algebraic operations of vector addition and multiplication by scalars</p> <p>A-level Papers 1 & 2: 10.3 – add vectors diagrammatically and perform the algebraic operations of vector</p>	<p>Adding vectors is used to find resultant forces in Chapter 16 Forces</p>	<p>10.2 Ex 10.2A</p>

		addition and multiplication by scalars	
<p>3 Vector geometry</p> <p>Students add vectors using the triangle law and are introduced to the parallelogram law which shows that that the order in which vectors are added is not important. Students go on to be introduced to the ratio theorem and the midpoint rule (a special case of the midpoint theorem)</p>	<ul style="list-style-type: none"> • Apply the triangle law to add vectors • Apply the ratio and midpoint theorems 	<p>AS Paper 1: 9.3 – add vectors diagrammatically and perform the algebraic operations of vector addition and multiplication by scalars and understand their geometric interpretations</p> <p>A-level Papers 1 & 2: 10.3 – add vectors diagrammatically and perform the algebraic operations of vector addition and multiplication by scalars and understand their geometric interpretations</p>	<p>10.3 Ex 10.3A Ex 10.3B</p>
<p>4 Position vectors</p> <p>Students learn that the position vector of a point is its position relative to the origin. They use this to calculate the relative displacement between two position vectors by subtracting the position vectors. Students calculate the distance between the two points by finding the magnitude of the relative displacement using Pythagoras' theorem.</p>	<ul style="list-style-type: none"> • Find the position vector of a point • Find the relative displacement between two position vectors 	<p>AS Paper 1: 9.4 – understand and use position vectors; calculate the distance between two points represented by position vectors</p> <p>A-level Papers 1 & 2: 10.4 – understand and use position vectors; calculate the distance between two points represented by position vectors</p>	<p>10.4 Ex 10.4A</p>

<p>5 Chapter review lesson</p> <p>Recap key points of chapter. Students to complete the exam-style questions, extension questions, or online end-of-chapter test</p>	<ul style="list-style-type: none"> Identify areas of strength and development within the content of the chapter 			See below
<p>Assessment</p> <p>Exam-style questions 10 in Student Book Exam-style extension questions 10 in Student Book End-of-chapter test 10 on Collins Connect</p>				

<p>CHAPTER 11 – Proof (4 Hours)</p>				
<p>Prior knowledge needed</p> <p>Proofs in context are flagged with boxes in every chapter. It is recommended to teach this chapter as a summation of proof and to ensure tested skills have been mastered. Students will need well developed algebra skills to write and understand proofs.</p>				
<p>Technology</p> <p>A spreadsheet package can be used to generate values.</p>				
One hour lessons	Learning objectives	Specification content	Topic links	Student Book references
<p>1 Proof by deduction</p> <p>Students are reminded that proof by deduction was used when proving the sine and cosine rules in Chapter 6 Trigonometry. They work through examples where conclusions are drawn by using general rules in mathematics and working through logical steps.</p> <p>Students should be made aware that this is the most commonly used method of proof throughout this specification</p>	<ul style="list-style-type: none"> Use proof by deduction 	<p>AS Paper 1/A-level Papers 1 & 2: 1.1 – understand and use the structure of mathematical proof, proceeding from given assumptions through a series of logical steps to a conclusion 1.1 – use methods of proof; including proof by deduction</p>	<p>Note: Proofs in context are flagged with boxes in every chapter. It is recommended to teach this chapter as a summation of proof and to ensure tested skills have been mastered</p>	<p>11.1 Ex 11.1A</p>

<p>2 Proof by exhaustion</p> <p>Students learn that when they complete a proof by exhaustion they need to divide the statement into a finite number of cases, prove that the list of cases identified is exhaustive and then prove that the statement is true for all the cases. I.e. they need to try all the options</p>	<ul style="list-style-type: none"> • Use proof by exhaustion • Work systematically and list all possibilities in a structured and ordered way 	<p>AS Paper 1/A-level Papers 1 & 2: 1.1 - understand and use the structure of mathematical proof, proceeding from given assumptions through a series of logical steps to a conclusion 1.1 – use methods of proof; including proof by exhaustion</p>		<p>11.2 Ex 11.2A</p>
<p>3 Disproof by counter example</p> <p>Students need to show that a statement is false by finding one exception, a counter example</p>	<ul style="list-style-type: none"> • Use proof by counter example 	<p>AS Paper 1/A-level Papers 1 & 2: 1.1 - understand and use the structure of mathematical proof, proceeding from given assumptions through a series of logical steps to a conclusion 1.1 – use methods of proof; including proof by counter example</p>		<p>11.3 Ex 11.3A</p>
<p>4 Chapter review lesson</p> <p>Recap key points of chapter. Students to complete the exam-style questions, extension questions, or online end-of-chapter test</p>	<ul style="list-style-type: none"> • Identify areas of strength and development within the content of the chapter 			<p>See below</p>
<p>Assessment Exam-style questions 11 in Student Book Exam-style extension questions 11 in Student Book End-of-chapter test 11 on Collins Connect</p>				

CHAPTER 12 – Data presentation and interpretation (11 Hours)

Prior knowledge needed

Chapter 1

Chapter 4				
Technology Calculators can be used to calculate many useful statistics – put the calculator into statistics mode. Use frequency tables on calculators. Use a calculator to calculate the mean and standard deviation using the frequency table option. Use graph-drawing software to plot cumulative frequencies. Use graphing software to create histograms. Use spreadsheet packages for the data set activities.				
One hour lessons	Learning objectives	Specification content	Topic links	Student Book references
1 Measures of central tendency Students review types of data, the median, the mode and the mean. Students consider which is the best measure of central tendency to use and why. They use Data set activity 12.1 to calculate the median and mean and comment critically on findings.	<ul style="list-style-type: none"> • Use discrete or continuous data • Use measures of central tendency: mean, median, mode 	AS Paper 2/A-level Paper 3: 2.3 – interpret measure of central tendency and variation	Links back to GCSE	12.1 DS 12.1
2 Measures of central tendency and spread Students review measures of spread; the range and interquartile range They use frequency table to calculate measure of central tendency and spread and estimate the mean from frequency tables.	<ul style="list-style-type: none"> • Use discrete, continuous, grouped or ungrouped data • Use measures of variation: range and interpercentile ranges 	AS Paper 2/A-level Paper 3: 2.3 – interpret measure of central tendency and variation	Links back to GCSE	12.1 Ex 12.1A

<p>3 Variance and standard deviation</p> <p>Students are introduced to variance and standard deviation and the fact that these measures use all the data items. Students go onto calculating variance and standard deviation using frequency tables.</p>	<ul style="list-style-type: none"> • Use measure of variation: variance and standard deviation • Use the statistic $s_{xx} = \sum(x - \bar{x})^2 = \sum x^2 \frac{(\sum x)^2}{n}$ • Use standard deviation $\sigma = \sqrt{\frac{s_{xx}}{n}}$ 	<p>AS Paper 2/A-level Paper 3: 2.3 – interpret measures of variation, extending to standard deviation 2.3 – be able to calculate standard deviation, including from summary statistics 2.4 – select or critique data presentation techniques in the context of a statistical problem</p>	<p>This is covered further in Book 2, Chapter 13 Statistical distributions</p>	<p>12.2 Ex 12.2A</p>
<p>4 Data cleaning</p> <p>Recap calculating variance and standard deviation from frequency tables and then introduce data cleaning as involving the identification and removal of any invalid data points from the data set. Students use Data set activity 12.2 to clean the data and give reasons for their omissions.</p>	<ul style="list-style-type: none"> • Use measure of variation: variance and standard deviation • Use the statistic $s_{xx} = \sum(x - \bar{x})^2 = \sum x^2 \frac{(\sum x)^2}{n}$ • Use standard deviation $\sigma = \sqrt{\frac{s_{xx}}{n}}$ 	<p>AS Paper 2/A-level Paper 3: 2.4 – select or critique data presentation techniques in the context of a statistical problem</p>		<p>12.2 DS 12.2</p>
<p>5 Standard deviation and outliers</p> <p>Student look at data sets that contain extreme values, if a value is more than three standard deviations away from the mean it should be treated as an outlier.</p> <p>Students use Data set activity 12.3 to apply what they have learnt so far, calculating the mean and standard deviation, and cleaning a section of the large data set.</p>	<ul style="list-style-type: none"> • Use measure of variation: variance and standard deviation • Use the statistic $s_{xx} = \sum(x - \bar{x})^2 = \sum x^2 \frac{(\sum x)^2}{n}$ • Use standard deviation $\sigma = \sqrt{\frac{s_{xx}}{n}}$ 	<p>AS Paper 2/A-level Paper 3: 2.3 – interpret measures of variation, extending to standard deviation 2.3 – be able to calculate standard deviation, including from summary statistics 2.4 – select or critique data presentation techniques in the context of a statistical problem</p>	<p>Normal distributions are covered in more depth in Book 2, Chapter 13 Statistical distributions</p>	<p>12.2 DS 12.3</p>

<p>6 Linear coding</p> <p>Students then use linear coding to make certain calculations easier. They apply a linear code to a section of large data in Data set activity 12.4.</p> <p>Learning from this and the previous three lessons is consolidated in exercise 12.2B</p>	<ul style="list-style-type: none"> • Understand and use linear coding 	<p>AS Paper 2/A-level Paper 3: 2.3 – interpret measures of variation, extending to standard deviation 2.3 – be able to calculate standard deviation, including from summary statistics 2.4 – select or critique data presentation techniques in the context of a statistical problem</p>		<p>12.2 DS 12.4 Ex 12.2B</p>
<p>7 Displaying and interpreting data – box and whisker plots and cumulative frequency diagrams</p> <p>Box and whiskers plots are used to compare sets of data. The way of showing outliers on a box and whisker plot and identifying outliers using quartiles is explained. Cumulative frequency diagrams are used to plot grouped data. (0, 0) should be plotted and the cumulative frequencies should be plotted at the upper bound of the interval. Percentiles are estimated from grouped data. Interpolation is used to find values between two points.</p>	<ul style="list-style-type: none"> • Interpret and draw frequency polygons, box and whisker plots (including outliers) and cumulative frequency diagrams • Use linear interpolation to calculate percentiles from grouped data 	<p>AS Paper 2/A-level Paper 3: 2.1 – Interpret diagrams for single-variable data, including understanding that area in a histogram represent frequency 2.1 – connect probability to distributions</p>		<p>12.3 Ex 12.3A</p>
<p>8 Displaying and interpreting data – histograms</p> <p>Students plot histograms and look at the distribution of the data. They apply what they have learnt to Data set activity 12.5, creating a histogram and performing linear interpolation.</p>	<ul style="list-style-type: none"> • Interpret and draw histograms 	<p>2.1 – Interpret diagrams for single-variable data, including understanding that area in a histogram represent frequency</p>		<p>12.3 DS 12.5 Ex 12.3B</p>

<p>9 Displaying and interpreting data – scatter graphs</p> <p>Students plot scatter diagrams with bivariate data and look for a correlation in the data.</p> <p>In Data set activity 12.6 students use data interpretation skills to investigate the evidence for global warming in the large data set.</p>	<ul style="list-style-type: none"> Describe correlation using terms such as positive, negative, zero, strong and weak 	<p>2.2 – understand informal interpretation of correlation</p> <p>2.2 – interpret scatter diagrams and regression lines for bivariate data, including recognition of scatter diagrams which include distinct sections of the population (calculations involving regression lines are excluded)</p> <p>2.2 – understand that correlation does not imply causation</p>		<p>12.3 DS 12.6 Ex 12.3C</p>
<p>10 Displaying and interpreting data – regression lines, lines of best fit, interpolation and extrapolation</p> <p>Having plotted scatter diagrams in the previous lesson students go on to look at the link between the line of best fit and regression line, $y = a + bx$ where b is the gradient and a is the y-intercept. Equations of regression lines are then explored. This is then used for interpolation and extrapolation to make predictions. Finally, students look at the correlation between two variables in Data set activity 12.7, and compare with another weather station.</p>	<ul style="list-style-type: none"> Use and interpret the equation of a regression line using statistical functions on your calculator and make predictions within the range of values of the explanatory variable and understand the dangers of extrapolation 	<p>2.2 – interpret scatter diagrams and regression lines for bivariate data, including recognition of scatter diagrams which include distinct sections of the population (calculations involving regression lines are excluded)</p> <p>2.2 – understand that correlation does not imply causation</p>	<p>Gradients and intercepts were covered in Chapter 4</p> <p>Coordinate geometry 1: Equations of straight lines</p>	<p>12.3 DS 12.7 Ex 12.3D</p>
<p>11 Chapter review lesson</p> <p>Recap key points of chapter. Students to complete the exam-style questions, extension questions, or online end-of-chapter test</p>	<ul style="list-style-type: none"> Identify areas of strength and development within the content of the chapter 			<p>See below</p>

Assessment

Exam-style questions 12 in Student Book

Exam-style extension questions 12 in Student Book

End-of-chapter test 12 on Collins Connect

CHAPTER 13 – Probability and statistical distributions (5 Hours)**Prior knowledge needed**

Chapter 1

Chapter 12

Technology

Use a calculator to perform exact binomial distribution calculations.

Use a calculator to perform cumulative binomial distribution calculations.

One hour lessons	Learning objectives	Specification content	Topic links	Student Book references
1 Calculating and representing probability Basic probability is recapped and sample space diagrams are used to determine the probability of equally likely events happening. Students go on to calculate probabilities of mutually exclusive and independent events using Venn diagrams and tree diagrams.	<ul style="list-style-type: none"> Use both Venn diagrams and tree diagrams to calculate probabilities 	AS Paper 2/A-level Paper 3: 3.1 – understand and use mutually exclusive and independent events when calculating probability	Links back to GCSE This will help you in Book 2, Chapter 12 Probability	13.1 Ex 13.1A
2 Discrete and continuous distributions – part 1 The term discrete and continuous data is recapped. A discrete random variable is	<ul style="list-style-type: none"> Identify a discrete uniform distribution 	AS Paper 2/A-level Paper 3: 3.1 – link to discrete and continuous distributions	You will use knowledge from Chapter 12 Data presentation and interpretation	13.2 Ex 13.2A

<p>then defined. Probability distribution tables are used to show all the possible values a discrete random variable can take along with the probability of each value occurring. When all events are equally likely they form a uniform distribution. Students go on to probability distributions of a random variable.</p>				
<p>3 Discrete and continuous distributions – part 2</p> <p>Continuous random variables are considered and when graphed a continuous line is used. The graph is called a probability density function (PDF), the area under a pdf shows the probability and sums to 1. Students then go on to find cumulative probabilities.</p>	<ul style="list-style-type: none"> Identify a discrete uniform distribution 	<p>AS Paper 2/A-level Paper 3: 3.1 – link to discrete and continuous distributions</p>	<p>You will use knowledge from Chapter 12 Data presentation and interpretation</p>	<p>13.2 Ex 13.2B</p>
<p>4 The binomial distribution</p> <p>Binomial distribution is about ‘success’ and ‘failure’ as there are only two possible outcomes to each trail. Students identify situations which can be modelled using the binomial distribution. They then calculate probabilities using the binomial distribution. Several examples are worked through.</p>	<ul style="list-style-type: none"> Use a calculator to find individual or cumulative binomial probabilities Calculate binomial probabilities using the notation $X \sim B(n, p)$ 	<p>AS Paper 2/A-level Paper 3: 4.1 – understand and use simple, discrete probability distributions (calculation of mean and variance of discrete random variables excluded), including the binomial distribution, as a model; calculate probabilities using the binomial distribution</p>	<p>You will need the skills and techniques learnt in Chapter 1 Algebra and functions 1: Manipulating algebraic expressions</p> <p>Knowing how to calculate binomial probabilities will help you in Chapter 14 Statistical sampling and hypothesis testing</p>	<p>13.3 Ex 13.3A</p>
<p>5 Chapter review lesson</p> <p>Recap key points of chapter. Students to complete the exam-style questions,</p>	<ul style="list-style-type: none"> Identify areas of strength and development within the content of the chapter 			<p>See below</p>

extension questions, or online end-of-chapter test				
Assessment Exam-style questions 13 in Student Book Exam-style extension questions 13 in Student Book End-of-chapter test 13 on Collins Connect				

CHAPTER 14 – Statistical sampling and hypothesis testing (6 Hours)				
Prior knowledge needed Chapter 12 Chapter 13				
Technology Use a calculator to calculate binomial cumulative probabilities. Use spreadsheet packages for the data set activities.				
One hour lessons	Learning objectives	Specification content	Topic links	Student Book references
1 Populations and samples Discuss the different terms and terminology within populations including; finite and infinite population, census, sample survey, sampling unit, sampling frame and target population. Move onto looking at the different types of sampling; random sampling, stratified sampling, opportunity sampling, quota sampling and systematic sampling. In Data set activity 14.1 , students compare a random sample	<ul style="list-style-type: none"> Use sampling techniques, including simple random, stratified sampling, systemic sampling, quota sampling and opportunity (or convenience) sampling Select or critique sampling techniques in the context of solving a statistical problem, including understanding that different sample can lead to different conclusions about population 	AS Paper 2/A-level Paper 3: 1.1 – mathematical proof 2.4 – recognise and interpret possible outliers in data sets and statistical diagrams 2.4 – select or critique data presentation techniques in the context of a statistical problem 2.4 – be able to clean data, including dealing with missing data, errors and outliers	You will need to know how to clean data for Chapter 12 Data presentation and interpretation	14.1 DS 14.1 Ex 14.1A

<p>with a systematic sample from the large data set and draw conclusions.</p>				
<p>2 Hypothesis testing – part 1</p> <p>The two different types of hypothesis are explained, the null and alternative hypotheses. 1-tail and 2-tail hypothesis are explained in relation to a six-sided die. Having carried out an experiment the null hypothesis can only be accepted or rejected based on the evidence, it cannot categorically be concluded from the findings.</p> <p>Students apply what they have learnt in this lesson in Data set activity 14.2.</p>	<ul style="list-style-type: none"> • Apply the language of statistical hypothesis testing, developed through a binomial model: null hypothesis, alternative hypothesis, significance level, test statistic, 1-tail test, 2-tail test, critical value, critical region, acceptance region, p-value • Have an informal appreciation that the expected value of a binomial distribution as given by np may be required for a 2-tail test • Conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret that results in context 	<p>AS Paper 2/A-level Paper 3: 5.1 – understand and apply statistical hypothesis testing, develop through a binomial model: null hypothesis, alternative hypotheses, significance level, test statistic, 1-tail test, 2-tail test, critical value, critical region, acceptance region, p-value 5.2 – conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret the results in context</p>	<p>You will need to know Chapter 13 Probability and statistical distributions</p>	<p>14.2 DS 14.2</p>
<p>3 Hypothesis testing – part 2</p> <p>Recap previous lesson and students go on to complete exercise 14.2A</p>	<ul style="list-style-type: none"> • Apply the language of statistical hypothesis testing, developed through a binomial model: null hypothesis, alternative hypothesis, significance level, test statistic, 1-tail test, 2-tail test, critical value, critical region, acceptance region, p-value • Have an informal appreciation that the expected value of a binomial distribution as given by np may be required for a 2-tail test • Conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret that results in context 	<p>AS Paper 2/A-level Paper 3: 5.1 – understand and apply statistical hypothesis testing, develop through a binomial model: null hypothesis, alternative hypotheses, significance level, test statistic, 1-tail test, 2-tail test, critical value, critical region, acceptance region, p-value 5.2 – conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret the results in context</p>		<p>14.2 Ex 14.2A</p>

<p>4 Significance levels – part 1</p> <p>Students look at significance levels being the probability of mistakenly rejecting the null hypothesis. The terms test statistic and critical region are explained and students move onto finding the critical region and critical value. They work through the examples up to the end of example 5.</p>	<ul style="list-style-type: none"> Appreciate that the significance level is the probability of incorrectly rejecting the null hypothesis 	<p>5.2 – understand that a sample is being used to make an inference about the population and appreciate that they significance level is the probability of incorrectly rejecting the null hypothesis</p>		<p>14.2</p>
<p>5 Significance levels – part 2</p> <p>Recap previous lesson, with a focus on how to calculate values using calculators instead of statistical tables. After working through the rest of the chapter from example 6 onwards, students go on to complete exercise 14.2B.</p>	<ul style="list-style-type: none"> Appreciate that the significance level is the probability of incorrectly rejecting the null hypothesis 	<p>5.2 – understand that a sample is being used to make an inference about the population and appreciate that they significance level is the probability of incorrectly rejecting the null hypothesis</p>		<p>14.2 Ex 14.2B</p>
<p>6 Chapter review lesson</p> <p>Recap key points of chapter. Students to complete the exam-style questions, extension questions, or online end-of-chapter test</p>	<ul style="list-style-type: none"> Identify areas of strength and development within the content of the chapter 			<p>See below</p>
<p>Assessment Exam-style questions 14 in Student Book Exam-style extension questions 14 in Student Book End-of-chapter test 14 on Collins Connect</p>				

CHAPTER 15 – Kinematics (10 Hours)

Prior knowledge needed

Chapter 2
Chapter 3
Chapter 4
Chapter 8
Chapter 9
Chapter 10

Technology

Graphics packages can be used to visualise problems.

One hour lessons	Learning objectives	Specification content	Topic links	Student Book references
<p>1 The language of kinematics</p> <p>Students are introduced to motion in a straight line and the vocabulary displacement, velocity and acceleration (vectors quantities) as opposed to distance, time and speed (scalar quantities). They use the SI unit for distance (metres) and time (seconds) to derive other units. Time permitting introduce the five SUAT equations.</p>	<ul style="list-style-type: none"> Find the SI units of displacement, velocity and acceleration 	<p>AS Paper 2/A-level Paper 3: 6.1 – understand and use fundamental quantities and units in the S.I. system: length, time, mass 6.1 – understand and use derived quantities and units; velocity and acceleration 7.1 – understand and use the language of kinematics; position; displacement; distance travelled; velocity; speed; acceleration</p>		<p>15.1 Ex 15.1A</p>
<p>2 Equations of constant acceleration – part 1</p> <p>The definition of acceleration ($a = \frac{(v-u)}{t}$) is used to derive the five SUVAT equations. Students have to work out which of the equations to use to solve problems.</p>	<ul style="list-style-type: none"> Derive and use the equations of constant acceleration 	<p>AS Paper 2/A-level Paper 3: 7.3 – understand, use and derive the formulae for constant acceleration for motion in a straight line</p>	<p>The SUVAT equations are used in Chapter 16 Forces</p>	<p>15.2 Ex 15.2A</p>
<p>3 Equations of constant acceleration – part 2</p> <p>Recap the five SUVAT equations from the previous lesson. Questions become more</p>	<ul style="list-style-type: none"> Derive and use the equations of constant acceleration 	<p>AS Paper 2/A-level Paper 3: 7.3 – understand, use and derive the formulae for constant acceleration for motion in a straight line</p>		<p>15.2 Ex 15.2B</p>

complicated in ex 15.2B and students are encouraged to draw a diagram to assist them in understanding the situation				
<p>4 Vertical motion – part 1</p> <p>Students continue to solve problems using the equations of constant acceleration but this time the acceleration is equal to gravity. They need to decide if gravity is influencing the situation in a positive or negative way.</p>	<ul style="list-style-type: none"> Derive and use the equations of constant acceleration, including for situation with gravity 	AS Paper 2/A-level Paper 3: 7.3 – understand, use and derive the formulae for constant acceleration for motion in a straight line		15.3 Ex 15.3A
<p>5 Vertical motion – part 2</p> <p>Recap the previous lesson and move on to look at when two objects are launched in different ways, students are advised to look for what the journeys have in common.</p>	<ul style="list-style-type: none"> Derive and use the equations of constant acceleration, including for situation with gravity 	AS Paper 2/A-level Paper 3: 7.3 – understand, use and derive the formulae for constant acceleration for motion in a straight line		15.3 Ex 15.3B
<p>6 Displacement-time and velocity-time graphs – part 1</p> <p>Where acceleration is constant, students construct graphs using straight lines and the concepts that the gradient of a displacement-time graphs is velocity and the gradient of a velocity-time graph is acceleration. The area under a velocity-time graph is used to calculate displacement. Students focus on displacement-time graphs.</p>	<ul style="list-style-type: none"> Draw and interpret displacement-time graphs and velocity-time graphs 	AS Paper 2/A-level Paper 3: 7.2 – understand, use and interpret graphs in kinematics for motion in a straight line; displacement against time and interpretation of gradient; velocity against time and interpretation of gradient and area under the graph		15.4 Ex 15.4A
<p>7 Displacement-time graphs and velocity-time graphs – part 2</p>	<ul style="list-style-type: none"> Draw and interpret displacement-time graphs and velocity-time graphs 	AS Paper 2/A-level Paper 3: 7.2 – understand, use and interpret graphs in kinematics for motion in a straight line;		15.4 Ex 15.4B

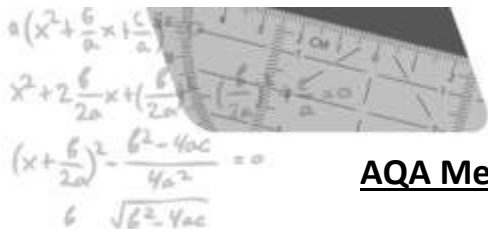
Recap the facts from last lesson and students go on to answer questions focusing on velocity-time graphs.		displacement against time and interpretation of gradient; velocity against time and interpretation of gradient and area under the graph		
8 Variable acceleration – part 1 Start the lesson with a quiz on differentiation and integrations. Students use differentiation and integration to solve problems where acceleration is not constant. This lesson focuses on the use of differentiation.	<ul style="list-style-type: none"> Use calculus to find displacement, velocity and acceleration when they are functions of time 	AS Paper 2/A-level Paper 3: 7.4 – use calculus in kinematics for motion in a straight line: ...	Links back to Chapter 8 Differentiation and Chapter 9 Integration	15.5 Ex 15.5A
9 Variable acceleration – part 2 Students use differentiation and integration to solve problems where acceleration is not constant. This lesson focuses on the use of integration.	<ul style="list-style-type: none"> Use calculus to find displacement, velocity and acceleration when they are functions of time 	AS Paper 2/A-level Paper 3: 7.4 – use calculus in kinematics for motion in a straight line: ...		15.5 Ex 15.5B
10 Chapter review lesson Recap key points of chapter. Students to complete the exam-style questions, extension questions, or online end-of-chapter test	<ul style="list-style-type: none"> Identify areas of strength and development within the content of the chapter 			See below
Assessment Exam-style questions 15 in Student Book Exam-style extension questions 15 in Student Book End-of-chapter test 15 on Collins Connect				

CHAPTER 16 – Forces (8 Hours)
Prior knowledge needed Chapter 10 Chapter 15

Technology				
Graphics packages can be used to visualise problems.				
One hour lessons	Learning objectives	Specification content	Topic links	Student Book references
<p>1 Forces</p> <p>Students are told the SI unit of force is the newton and mass is the kilogram. They use vectors, Pythagoras' theorem and trigonometry to find resultant forces. They also use the fact that if the resultant force is equal to zero then an object is in equilibrium.</p>	<ul style="list-style-type: none"> Find a resultant force by adding vectors Find the resultant force in a given direction 	<p>AS Paper 1: 9.5 – use vectors to solve problems in pure mathematics and in context, including forces</p> <p>A-level Papers 1 & 2: 10.5 – use vectors to solve problems in pure mathematics and in context, including forces</p> <p>AS Paper 2/A-level Paper 3: 6.1 – understand and use derived quantities and units; force and weight 8.1 – understand the concept of a force</p>	Builds on Chapter 10 Vectors	16.1 EX 16.1A
<p>2 Newton's laws of motion part one</p> <p>Students are told Newton's laws of motion. They apply these to problems. Students are then introduced to the five different types of force. These are represented diagrammatically so that they are clearly distinguishable. Students then go on to use simplified models to represent real-life situations and solve problems</p>	<ul style="list-style-type: none"> Apply Newton's laws and the equations of constant acceleration to problems involving forces Distinguish between the forces of reaction, tension, thrust, resistance and weight Represent problems involving forces in a diagram 	<p>AS Paper 2/A-level Paper 3: 8.1 – understand the concept of a force; understand and use Newton's first law 8.2 – understand and use Newton's second law for motion in a straight line (restricted to forces in two perpendicular directions or simple cases of forces given as 2-D vectors) 8.3 – understand and use weight and motion in a straight line under gravity</p>		16.2 Ex 16.2A
<p>3 Newton's laws of motion part two</p>	<ul style="list-style-type: none"> Apply Newton's laws and the equations of constant acceleration to problems involving forces 	AS Paper 2/A-level Paper 3:		16.2 Ex 16.2B

<p>Students are told Newton's laws of motion. They apply these to problems. Students are then introduced to the five different types of force. These are represented diagrammatically so that they are clearly distinguishable. Students then go on to use simplified models to represent real-life situation and solve problems</p>	<ul style="list-style-type: none"> • Distinguish between the forces of reaction, tension, thrust, resistance and weight • Represent problems involving forces in a diagram 	<p>8.1 – understand the concept of a force; understand and use Newton's first law 8.2 – understand and use Newton's second law for motion in a straight line (restricted to forces in two perpendicular directions or simple cases of forces given as 2-D vectors) 8.3 – understand and use weight and motion in a straight line under gravity</p>		
<p>4 Vertical motion</p> <p>Students move from particles travelling horizontally to particles travelling in vertically. When particles travel vertically they have to consider the effects of gravity and weight.</p>	<ul style="list-style-type: none"> • Distinguish between the forces of reaction, tension, thrust, resistance and weight • Model situations such as lifts, connected particles and pulleys 	<p>AS Paper 2/A-level Paper 3: 8.3 – understand and use weight and motion in a straight line under gravity; gravitational acceleration , g, and its value in S>I> units to varying degrees of accuracy 8.4 – understand and use Newton's third law</p>		<p>16.3 Ex 16.3A</p>
<p>5 Connected particles – part 1</p> <p>More complex problems are solved using Newton's laws and simultaneous equations due to the consideration of resistive forces. Modelling assumptions are made and shown with diagrams when answering questions. The connected particles considered are particles suspended on ropes, vehicles towing caravans and lifts.</p>	<ul style="list-style-type: none"> • Model situations such as lifts, connected particles and pulleys • Represent problems involving forces in a diagram 	<p>AS Paper 2/A-level Paper 3: 8.4 - understand and use Newton's third law; equilibrium of forces on a particle and motion in a straight line; application to problems involving smooth pulleys and connected particles</p>		<p>16.4 Ex 16.4A</p>
<p>6 Connected particles – part 2</p> <p>Recap on the chapter so far. Students complete exercise 16.4B.</p>	<ul style="list-style-type: none"> • Model situations such as lifts, connected particles and pulleys • Represent problems involving forces in a diagram 	<p>AS Paper 2/A-level Paper 3: 8.4 - understand and use Newton's third law; equilibrium of forces on a particle and motion in a straight line; application to</p>		<p>16.4 Ex 16.4B</p>

		problems involving smooth pulleys and connected particles		
<p>7 Pulleys</p> <p>Connected particles are now considered in the form of pulleys. The main difference being that when an object is connected via a pulley it will be travelling in a different direction. Students should again draw diagrams representing the situation in the question. They solve problems using Newton's laws of motion, the SUVAT equations and simultaneous equations.</p>	<ul style="list-style-type: none"> • Model situations such as lifts, connected particles and pulleys • Represent problems involving forces in a diagram 	<p>AS Paper 2/A-level Paper 3: 8.4 - understand and use Newton's third law; equilibrium of forces on a particle and motion in a straight line; application to problems involving smooth pulleys and connected particles</p>		<p>16.5 Ex 16.5A</p>
<p>8 Chapter review lesson</p> <p>Recap key points of chapter. Students to complete the exam-style questions, extension questions, or online end-of-chapter test</p>	<ul style="list-style-type: none"> • Identify areas of strength and development within the content of the chapter 			<p>See below</p>
<p>Assessment Exam-style questions 16 in Student Book Exam-style extension questions 16 in Student Book End-of-chapter test 16 on Collins Connect</p>				



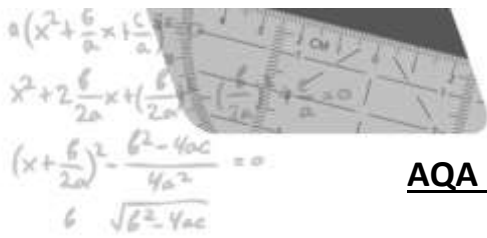
AQA Mechanics 1 – Learning Programme

Autumn Term 1 2017/2018

Week	Chapter	Learning Objectives	Independent Work	✓
1 & 2 (4/9) (11/9)	2: Kinematics in one dimension	<ul style="list-style-type: none"> ▪ Define displacement, velocity and acceleration ▪ Understand and interpret displacement-time graphs and velocity-time graphs ▪ Solve problems involving motion under constant acceleration using standard formulae ▪ Solve problems involving vertical motion under gravity 	EXERCISE 2B EXERCISE 2C Chapter 2 Test yourself	
3 (18/9)	3: Kinematics in two dimensions	<ul style="list-style-type: none"> ▪ Plot and interpret paths given a position vector ▪ Find magnitudes and directions of vectors ▪ Apply and use the constant acceleration equations in dimensions ▪ Use velocity triangles to solve simple problems 	EXERCISE 3C EXERCISE 3D Chapter 3 Test yourself	
4 (25/9)	Term 1a Course suitability assessment			
5 - 7 (2/10) (9/10) (16/10)	4: Forces	<ul style="list-style-type: none"> ▪ Identify the forces acting on a body ▪ Draw force diagrams and resolve forces into components ▪ Find resultant forces and understand that the resultant forces is zero when the forces are in equilibrium ▪ Write forces as vectors ▪ Use the friction inequality 	EXERCISE 4E EXERCISE 4F EXERCISE 4G Chapter 4 Test yourself	

Autumn Term 2 2017/2018

Week	Chapter	Learning Objectives	Independent Work	✓
1&2 (30/10) (6/11)	5: Newton's laws of motion	<ul style="list-style-type: none"> ▪ Apply Newton's three laws of motion ▪ Solve problems where the forces are in equilibrium ▪ Solve problems where a particle is accelerating 	EXERCISE 5B Chapter 5 Test yourself	
3 (13/11)	6: Connected particles	<ul style="list-style-type: none"> ▪ Solve problems of motion involving connected particles 	EXERCISE 6A Chapter 6 Test yourself	
4&5 (20/11) (27/11)	7: Projectiles	<ul style="list-style-type: none"> ▪ Find the time of flight of a projectile ▪ Find the range of a projectile ▪ Find the maximum height of a projectile 	EXERCISE 7A EXERCISE 7B Chapter 7 Test yourself	
6 (4/12)	Term 1b PPE (Mechanics 1 Full Exam Paper , 1hr 30 min)			
7 (11/12)	8: Momentum	<ul style="list-style-type: none"> ▪ Define the momentum of an object ▪ Understand what happens to momentum of a particle during collision ▪ Use the principle of conservation of momentum to calculate momentum after collision, in both one and two dimensions 	EXERCISE 8A EXERCISE 8B Chapter 8 Test yourself	



AQA Core 3 – Learning Programme

Summer term 2 2016/2017

Chapter	Learning Objectives	Independent Work	✓
1: Functions	<ul style="list-style-type: none"> ▪ Understand Function notation ▪ Describe the domain and range for a given function ▪ Find composite functions in the form $fg(x)$ ▪ Find inverse functions 	Chapter 1 MIXED EXERCISE Chapter 1 Test yourself	
2: Transformations of graphs and the modulus function	<ul style="list-style-type: none"> ▪ Sketch graphs of the modulus function in the form $y= f(x)$ and $y=f(x)$ ▪ Solve an equation involving a modulus ▪ Apply a combination of transformations to a graph ▪ Sketch transformations and labelling the co-ordinates of given point 	Chapter 2 MIXED EXERCISE Chapter 2 Test yourself	
3: Inverse trigonometric functions and secant, cosecant and cotangent	<ul style="list-style-type: none"> ▪ Evaluate secant, cosecant and cotangent functions of angles ▪ Use secant, cosecant and cotangent functions to solve equations ▪ Combine the secant, cosecant and cotangent functions with the Pythagorean identities ▪ Work with the inverse trig functions; arcsin, arcos, and arctan. ▪ draw the graphs of the inverse functions 	EXERCISE 3D Chapter 3 Test yourself	
4: The number e and calculus	<ul style="list-style-type: none"> ▪ Recognise the number e ▪ Differentiate and integrate e^{kx} ▪ Use exponential functions and logarithmic functions in calculus 	Chapter 4 MIXED EXERCISE	

Autumn Term 1 2017/2018

Week	Chapter	Learning Objectives	Independent Work	✓
1&2 (4/9) (11/9)	5: Further differentiation and the chain rule	<ul style="list-style-type: none"> ▪ Find the derivatives of $\sin x$ and $\cos x$ ▪ Differentiate composite functions using the chain rule ▪ Use the relationship $dy/dx = \frac{1}{dx/dy}$ 	REVISION EXERCISE 5 Chapter 5 Test yourself	
2&3 (11/9) (18/9)	6: Differentiation using the product rule and the quotient rule	<ul style="list-style-type: none"> ▪ Differentiate using the product rule ▪ Differentiate using the quotient rule ▪ Differentiate $\tan x$, $\cot x$, $\sec x$ and $\csc x$ 	REVISION EXERCISE 6 Chapter 6 Test yourself	
4 (25/9)	Term 1a Course suitability assessment			
5 & 6 (2/10) (9/10)	8: Integration by inspection and substitution	<ul style="list-style-type: none"> ▪ Integrate expressions using the reverse idea of the chain rule ▪ Integrate trigonometric expressions ▪ Integrate expressions of the form $\frac{f'(x)}{f(x)}$ 	REVISION EXERCISE 8 Chapter 8 Test yourself	
7 (16/10)	9: Integration by parts and standard integrals	<ul style="list-style-type: none"> ▪ Integrate expressions using integration by parts ▪ Use relevant standard integrals quoted in the formulae booklet 	REVISION EXERCISE 9 Chapter 9 Test yourself	

Autumn Term 2 2017/2018

Week	Chapter	Learning Objectives	Independent Work	✓
1 (30/10)	4: The number and calculus	<ul style="list-style-type: none"> ▪ Recognise the number e ▪ Differentiate and integrate e^{kx} ▪ Use exponential functions and logarithmic functions in calculus 	REVISION EXERCISE 4 Chapter 4 Test yourself	
2 (6/11)	7: Numerical solution of equations and iterative methods	<ul style="list-style-type: none"> ▪ Locate roots of equations by change of sign ▪ Use numerical methods to find solutions of equations ▪ Understand the principle of iteration ▪ Understand how cobweb and staircase diagrams demonstrate convergence or divergence for equations of the form $x=g(x)$ 	REVISION EXERCISE 7 Chapter 7 Test yourself	
3 (13/11)	10: Volume of revolution and numerical integration	<ul style="list-style-type: none"> ▪ Evaluate volumes of revolution ▪ Use the mid-ordinate rule to find a numerical approximation for a definite integral ▪ Use Simpson's rule to find a numerical approximation for a definite integral 	REVISION EXERCISE 10 Chapter 10 Test yourself	
4&5 (20/11) (27/11)	Core 3 Revision and Exam Practice	<ul style="list-style-type: none"> ▪ Revision by topic ▪ Past paper practice 		
6 (4/12)	Term 1b PPE (Core 3 Full Exam Paper , 1hr 30 min)			