Year 12 Maths - Pure and Mechanics Teacher

Topic		Ref	Ex
Quadratics	**Solving Quadratic Equations** • By factorising • Using the formula • By completing the square • Using the calculator function • Find and interpret the discriminant of a quadratic expression • Solving equations that can be transformed into a quadratic using a substitution.	P2.3	P2A P2B P2C P2D P2E P2F
	Quadratic Graphs • Write a quadratic in completed square form. Use this form to identify the vertex of a quadratic and to sketch the curve.	P2.3	P2D
	Modelling with Quadratics • Use and apply models that involve quadratic functions	P2.3	P2F
Simultaneous Equations	**Linear Simultaneous Equations** • Solve linear simultaneous equations using elimination or substitution. Interpretation as finding point of intersection of straight lines.	P2.4	P3A
	One Linear, One Quadratic • Solving a pair of simultaneous equations involving one linear and one quadratic equation. • Use of discriminant to solve problems involving the intersection of a straight line and a quadratic graph. • Interpret algebraic solutions graphically.	P2.4	P3B P3C
Inequalities	**Linear Inequalities** - Solution of linear inequalities, including brackets, fractions and negative numbers - Represent solutions on a number line	P2.5	P3D P3F
	Quadratic Inequalities - Solution of quadratic inequalities, including those with x in the denominator of a fraction.	P2.5	P3E
	Set Notation - Express solutions through the correct use of 'and' and 'or', or through set notation e.g. $\{x: a < x\} \cap \{x: x < b\}$	P2.5	P3D P3E
	Inequalities on Graphs - Represent linear and quadratic inequalities graphically by shading regions	P2.5	P3F P3G
Graphs and Transformations	**Important Graphs** Know the shape of be able to sketch the following graphs: • Cubic graphs • Quartic graphs • Reciprocal graphs of the form $y = a/x$ and $y = a/x^2$	P2.7	P4A P4B P4D
	Solutions to Equations • Use intersection points of graphs to solve equations. • Interpret algebraic solution of equations graphically	P2.7	P4A P4B P4D

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Topic		Ref	Ex
Graphs and Transformations (cont.)	**Transformations of Graphs** • Understand the effect of simple transformations on the graph of $y = f(x)$ including sketching the associated graphs. • Transformations will be of the form: $y = af(x)$, $y = f(x) + a$, $y = f(x+a)$, $y = f(ax)$, where a is a constant. • Be able to express the transformations involved in terms of translations, reflections and stretches.	P2.8	P4E P4F
Quantities and Units in Mechanics	**Language of Kinematics** • understand the concept of a mathematical model, and be able to abstract from a real-world situation to a mathematical description (model); • know the language used to describe simplifying assumptions; • understand the particle model; • be familiar with the basic terminology for mechanics; • be familiar with commonly-made assumptions when using these models; • understand and use fundamental quantities and units in the S.I. system: length, time and mass; • Understand that units behave in the same way as algebraic quantities, e.g. meters per second is $m/s = m \times 1/s = ms^{-1}$	A6.1	A8A A8B A8C A8D

Kinematics Graphs (constant acceleration)	• Understand and use the language of kinematics: position; displacement; distance travelled; velocity; speed; acceleration.
	• 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
		A7.1	A9A
			A9B

Assessment 1			
Coordinate Geometry – Straight Lines	**Straight lines** • Calculate the gradient of a line joining a pair of points. • Find the equation of a straight line given (i) a gradient and a point or (ii) two points • Understand and use the equation of a straight line including the forms: $y - y_1 = m(x - x_1)$ and $ax + by + c = 0$ • Find the length and midpoint of a line segment given the coordinates of its endpoints. • Equations of parallel and perpendicular lines • Use straight line graphs to construct mathematical models	P3.1	P5A P5B P5C P5D P5E P5F P5G P5H

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Topic		Ref	Ex
Coordinate Geometry – Circles	**Equation of a circle** • Know how to find the equation of a circle in the form: $(x – a)^2 + (y – b)^2 = r^2$ • use the equation of a circle in expanded form $x^2+y^2+2gx+2fy+c=0$ and identify the centre and radius of the circle by completing the square	P3.2	P6A P6B
	Problems involving circles • Solve problems involving circles, tangents and straight lines. • Know the following circle properties: the angle in a semicircle is a right angle; the perpendicular from the centre to a chord bisects the chord; the perpendicularity of radius and tangent. Use these to help solve problems involving circles.	P3.2	P6C P6D P6E P6F
Kinematics Equations (constant acceleration)	**SUVAT Equations** • Understand and derive the formulae for constant acceleration for motion in a straight line SUVAT • Recognise when it is appropriate to use the SUVAT formulae for constant acceleration • Solve kinematics problems using constant acceleration formulae • 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 • Solve problems involving vertical motion under gravity.	A7.2 A7.3	A9C A9D A9E
Assessment 2			
Vectors in 2D	**Definitions and arithmetic operations** • Use vectors in two-dimensions in column vector form and **i**, **j** unit vector form. • Calculate the magnitude and direction of a vector • Convert between component form and magnitude/direction form. • Add vectors diagrammatically and perform the algebraic operations of vector addition and multiplication by scalars, and understand their geometrical interpretations.	P9.1 P9.2 P9.3	P11A P11B P11C
	Position vectors and modelling with vectors • Understand and be able to use position vectors, know that $\overrightarrow{AB} = b - a$ • Calculate the distance between two points represented by position vectors • Find the position vector of a point C dividing AB in a given ratio • Use familiar shapes to illustrate the difference between 2 vectors and vector addition, e.g. parallelogram, rectangle. • Use vectors to solve problems in context including speed and distance calculations	P9.4 P9.5	P11D P11E P11F

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Topic		Ref	Ex
Integration	**Indefinite Integrals** • Understand integration as the reverse process of differentiation • be able to integrate x^n (excluding n = −1), and related sums, differences and constant multiples • Understand the need for +c • Given f '(x) and a point on the curve, find an equation of the curve in the form y=f(x).	P8.1 P8.2	P13A P13B P13C
	Definite Integrals • Be able to evaluate definite integrals using correct notation • Use a definite integral to find the area bounded by a curve and the x-axis • Find areas bounded by curves and straight lines	P8.3	P13D P13E P13F P13G
Forces and Newton's Laws	**Newton's Second Law** • Understand and use Newton's second law F = ma for motion in a straight line (no resolving forces) • Solve problems involving motion in a straight line with constant acceleration in vector form, where the forces are given in **i**, **j** form or as column vectors	A8.2	A10A A10B
	Newton's Third Law • Understand and use Newton's third law; equilibrium of forces on a particle and motion in a straight line; • Solve problems involving connected particles which can be considered as a whole system or separate parts. • Solve problems involving smooth pulleys.	A8.4	A10C A10D A10E A10F
Assessment 3			

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Topic		Ref	Ex
Kinematics 2 (Variable acceleration)	**Determine Rates of Change for kinematics** • Understand that displacement, velocity and acceleration may be given as functions of time • Use calculus (differentiation) in kinematics to model motion in a straight line for a particle moving with variable acceleration; • Understand that gradients of the relevant graphs link to rates of change; • Know how to find max and min velocities by considering zero gradients and understand how this links with the actual motion (i.e. acceleration = 0).	A7.4	A11A A11B A11C
	Use of Integration for Kinematics problems • Use calculus (integration) in kinematics to model motion in a straight line for a particle moving under the action of a variable force; • Understand that the area under a graph is the integral, which leads to a physical quantity; • Know how to use initial conditions to calculate the constant of integration and refer back to the problem.	A7.4	A11D
	Constant Acceleration Formulae • Use calculus to derive the constant acceleration formulae	A7.4	A11E
Exponentials and Logarithms	**Exponential Functions** • Sketch graphs of the form $y = a^x$ and $y = e^x$, and transformations of these graphs. ($a > 0$) • Understand the difference in shape between $a > 1$ and $a < 1$. • Know that the gradient of e^{kx} is equal to ke^{kx} and hence understand why the exponential model is suitable in many applications • Use and interpret models that use exponential functions – exponential growth and decay.	P6.1 P6.2 P6.7	P14A P14B P14C
Exponentials and Logarithms (cont.)	**Logarithms** • Know and be able to use the definition of $\log_a n = x$ as equivalent to $a^x = n$, where a is positive and $x \geq 0$ • Understand and use the laws of logarithms • Solve equations of the form $a^x = b$ • Know and be able to use the natural logarithm function ln x and its graph • Use logarithms to estimate the values of constants in non-linear models of the form $y=ax^n$ and $y=kb^x$, given data for x and y	P6.3 P6.4 P6.5 P6.6	P14D P14E P14F P14G P14H
Assessment 4			