A2 Maths Self Assessment **Name:**_____

	AS topics	All the things you need to know *AS in bold	RAG	Test	RAG

A	Proof	• **Understand and use correct mathematical language and grammar.**
		• **Understand and use methods of proof**
		  • **Simple proof of odd & even numbers**
		  • **Proof by deduction**
		  • **Proof by exhaustion**
		  • **Disproof by counter-example**
		• Proof by contradiction (including proof of the irrationality of √2 and the infinity of primes, and application to unfamiliar proofs).			

B	Algebra and Functions	• **Laws of indices**
		• **Surds, including rationalising the denominator**
		• **Quadratic functions and their graphs**
		• **Using the discriminant**
		• **Completing the square**
		• **Solving quadratic equations**
		• **Solving simultaneous equations (elimination & substitution)**
		• **Solving linear & quadratic inequalities and representing graphically**
		• **Manipulate polynomials (expanding, factorising division)**
		• **Factor Theorem**
		• Simplify rational expressions including by factorising and cancelling, and algebraic division (by linear expressions only).
		• **Sketch & use graphs of functions**
		  • **Polynomials**
		  • **Reciprocals (including asymptotes)**
		  • The modulus of a linear function
		• Understand and use composite functions; inverse functions and their graphs.
		• **Transformations of $y = f(x)$ associated graphs including $y = af(x)$, $y = f(x) + a$, $y = f(x + a)$, $y = f(ax)$**
		• Be able to combine transformations
		• Decompose rational functions into partial fractions
		• Use of functions in modelling, including consideration of limitations and refinements of the models			

C	Coordinate Geometry	• **Equation of a straight line in all forms including $y - y_1 = m(x - x_1)$**
		• **Gradients that are parallel or perpendicular**
		• **Equations of a circle in the form $(x - a)^2 + (y - b)^2 = r^2$**
		• **Completing the square to find the centre and radius of a circle**
		• **use of the following properties:**
		  • **The angle in a semicircle is a right angle**
		  • **The perpendicular from the centre to a chord bisects the chord**
		  • **The radius of a circle at a given point on its circumference is perpendicular to the tangent to the circle at that point**
		• Understand and use the parametric equations of curves and conversion between Cartesian and parametric forms
		• Use parametric equations in modelling in a variety of contexts.			

D	Sequences & Series	• Understand and use the binomial expansion of $(a + bx)^n$ for positive integer n • The notations $n!$, nCr and $\binom{n}{r}$ • Extend to all ration n, including approximation as long as $\left\|\frac{bx}{a}\right\| < 1$			

		• Sequences including $N^{th}\ Term,\ x_{n+1} = f(xn)$; increasing sequences; decreasing sequences; periodic sequences. • Understand and use sigma notation for sums of series. • Arithmetic seq & series including Nth Term & sum to n terms • Geometric seq & series including Nth Term, sum of finite and sum to infinity of a convergent series, the use of |r | < 1 & modulus notation. • Sequence and series in modelling			

E	Trigonometry	• **Understand & use the definitions of sin, cos and tan**
		• **Sine and cosine rules**
		• **Area of a triangle in the form ½ ab sin C**
		• Radians including arc length and area of sector
		• Small angle approximations $\sin\theta \approx \theta,\ \cos\theta \approx 1-\frac{\theta^2}{2},\ \tan\theta \approx \theta$
		• **Understand & use the graphs of trig**
		• Know the exact values of trig for common values of π
		• Understand and use the definitions of secant, cosecant and cotangent and of arcsin, arccos and arctan; their relationships to sine, cosine and tangent; understanding of their graphs; their ranges and domains
		• **Be able to use the trig identities**
		  • $\tan\theta \equiv \frac{\sin\theta}{\cos\theta}$
		  • $\sin^2\theta + \cos^2\theta \equiv 1$;
		  • $\sec^2\theta \equiv 1+\tan^2\theta$ and $\text{cosec}^2\theta \equiv 1+\cot^2\theta$
		• Double angle formula and their proofs
		• Understand and use expressions for $a\cos\theta + b\sin\theta$ in the equivalent forms of $r\cos(\theta \pm \alpha)$ or $r\sin(\theta \pm \alpha)$
		• **Solve trig equations in a given interval, including quadratic equations of trig and multiples of unknown angles**
		• Construct proofs involving trigonometric functions and identities
		• Use trigonometric functions to solve problems in context, includinguding problems involving vectors, kinematics and forces			

F	Exponentials & Logarithms	• **Know and use the function a^x and its graphs**
		• **Know and use the function e^x and its graphs**
		• **Know that the gradient of e^{kx} = ke^{kx}**
		• **Know and use the definition of a log x as the inverse of x^a**
		• **Know and use the function *ln x* and its graph**
		• **Know and use ln x as the inverse function of e^x**
		• **Understand and use the laws of logarithms:**
		  • $\log_a x + \log_a y \equiv \log_a(xy)$
		  • $\log_a x - \log_a y \equiv \log_a\left(\frac{x}{y}\right)$
		  • $k\log_a x \equiv \log_a x^k$
		• **Solve equations of the form a^x = b**
		• **Use log graphs to estimate parameters of y = ax^n & y = kb^n**
		• **Use exponential growth and decay to model questions**			

G	Differentiation	• **Differentiation from first principles** • **f(*x*) is the gradient of the tangent to the graph of *y* = f(*x*) at a point** • **Differentiation of functions.** • Differentiate exponentials, logs & sin *kx*, cos *kx*, tan *kx* • **Understand the use of second derivatives as the rate of change of gradient & to find the maxima and minima.**			

		• Link second derivatives to convex and concave sections of curves and points of inflection • **Apply differentiation to gradients, tangents and normals, maxima and minima and stationary points** & points of inflection. • **Identify where functions are increasing and decreasing.** • Differentiate using the product rule, the quotient rule and the chain rule, including problems involving connected rates of change and inverse functions. • Differentiate simple functions and relations defined implicitly or parametrically, for first derivative only • Construct simple differential equations in pure mathematics and in context, (contexts may include kinematics, population growth and modelling the relationship between price and demand).			
H	Integration	• **Know and use the Fundamental Thm of Calculus (Indefinite integration as the reverse of differentiation)** • **Integration of functions.** • Integrate e^{kx}, $\frac{1}{x}$, sin *kx*, cos *kx* • **Use definite integrals to find the area under a curve.** • Use definite integrals to find the area between two curves • Understand and use integration as the limit of a sum • Carry out simple cases of integration by substitution and integration by parts; understand these methods as the inverse processes of the chain and product rules respectively • Integrate using partial fractions that are linear in the denominator • Evaluate the analytical solution of simple first order differential equations with separable variables, including finding particular solutions • Interpret the solution of a differential equation in the context of solving a problem, including identifying limitations of the solution; includes links to kinematics			
I	Numerical Methods	• Locate roots of f( ) x = 0 by considering changes of sign of f( ) x in an interval of x on which f( ) x is sufficiently well-behaved. • Understand how change of sign methods can fail. • Solve equations approximately using simple iterative methods • Be able to draw associated cobweb and staircase diagrams. • Solve equations using the Newton-Raphson method • Understand and use numerical integration of functions, including the use of the trapezium rule and estimating the approximate area under a curve and limits that it must lie between • Use numerical methods to solve problems in context.			
J	Vectors	• **Use vectors in two dimensions** • Use vectors in three dimensions • **Calculate the magnitude and direction of a vector using i & j format** • **Be able to add vectors and multiply by scalars** • **Understand and use position vectors & find the distance between two points** • **Use vectors to solve problems in forces** & kinematics			
K	Statistical sampling	• **Understand and use the terms 'population' and 'sample'.** • **Use samples to make informal inferences about the population.** • **Understand and use sampling techniques, including simple random sampling and opportunity sampling.** • **Select or critique sampling techniques in the context of solving a statistical problem, including understanding that different samples can lead to different conclusions about the population**.			

L	Data presentation & interpretation	• **Interpret diagrams for single-variable data, including understanding that area in a histogram represents frequency. Link to probability distributions.** • **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).** • **Understand informal interpretation of correlation and that correlation does not imply causation.** • **Interpret measures of central tendency and variation, extending to standard deviation. Be able to calculate standard deviation, including from summary statistics.** • **Recognise and interpret possible outliers in data sets and statistical diagrams. Select or critique data presentation techniques in the context of a statistical problem. Be able to clean data, including dealing with missing data, errors and outliers.**			
M	Probability	• **Understand and use mutually exclusive and independent events when calculating probabilities. Link to discrete and continuous distributions** • Understand and use conditional probability, including the use of tree diagrams, Venn diagrams, two-way tables • Understand and use the conditional probability formula $P(A\|B) = \frac{P(A \cap B)}{P(B)}$ • Modelling with probability, including critiquing assumptions made and the likely effect of more realistic assumptions			
N	Statistical distributions	• **Understand and use simple, discrete probability distributions (calculation of mean and variance of discrete random variables is excluded), including the binomial distribution, as a model; calculate probabilities using the binomial distribution.** • Understand and use the Normal distribution as a model; find probabilities using the Normal distribution. • Link to histograms, mean, standard deviation, points of inflection and the binomial distribution. • Select an appropriate probability distribution for a context, with appropriate reasoning, including recognising when the binomial or Normal model may not be appropriate			
O	Statistical hypothesis testing	• **Understand and 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** • Extend language to correlation coefficients as measures of how close data points lie to a straight line and be able to interpret a given correlation coefficient using a given p-value or critical value (calculation of correlation coefficients is excluded) • **Conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret the results in context.** • **Understand that a sample is being used to make an inference about the population and appreciate that the significance level is the probability of incorrectly rejecting the null hypothesis**. • Conduct a statistical hypothesis test for the mean of a Normal distribution with known, given or assumed variance and interpret the results in context			
P	Quantities and units in mechanics	• **Understand and use fundamental quantities and units in the SI system: length, time, mass.** • **Understand and use derived quantities and units: velocity, acceleration, force, weight** & moments			

Q	Kinematics	• **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.** • **Understand, use and derive the formulae for constant acceleration for motion in a straight line** & in 2 dimensions using vectors • **Use calculus in kinematics for motion in a straight line:** $v=\frac{dr}{dt}$, $a=\frac{dv}{dt}=\frac{d^2r}{dt^2}$, $r=\int v\,dt$, $v=\int a\,dt$; & extend to 2 dimensions using vectors • Model motion under gravity in a vertical plane using vectors; projectiles			
R	Forces & Newton's Laws	• **Understand the concept of a force; understand and use Newton's first law.** • **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 2D vectors)** • Use Newton's second Law where forces need to be resolved • **Understand and use weight and motion in a straight line under gravity; gravitational acceleration, g, and its value in SI units to varying degrees of accuracy.** • **Understand and use Newton's third law; equilibrium of forces on a particle and motion in a straight line (restricted to forces in two perpendicular directions or simple cases of forces given as 2D vectors); application to problems involving smooth pulleys and connected particles** • Use Newton's Third Law to resolve forces in 2 dimensions; equilibrium of a particle under coplanar forces • Understand and use addition of forces; resultant forces; dynamics for motion in a plane. • Understand and use the $F \leq \mu R$ model for friction; coefficient of friction; motion of a body on a rough surface; limiting friction and statics.			
S	Moments	• Understand and use moments in simple static contexts			