# Park House School - Year 13 Feb/March Mocks

## Maths Assessment Manifest

- You will have 3 Maths papers, paper 1 and paper 2 is pure only, paper 3 is statistics and mechanics
- Each paper will be 100 marks
- Each paper will be 2 hours
- You are expected to spend 1 minute on each mark and then 20 minutes checking your answers.

### Pure

| Topics | Red | Amber | Green |
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| I can understand and use the structure of mathematical proof, proceeding from given assumptions through a series of logical steps to a conclusion; use methods of proof including:<br>• Proof by deduction<br>• Proof by exhaustion<br>• Disproof by counter example<br>• Proof by contradiction | | | |
| I can understand and use the laws of indices for all rational exponents | | | |
| I can use and manipulate surds including rationalising the denominator | | | |
| I can work with quadratic functions and their graphs | | | |
| I can find the discriminant of a quadratic function, including the conditions for real and repeated roots | | | |
| I can complete the square | | | |
| I can find solutions of quadratic equations | | | |
| I can solve quadratic equations in a function of the unknown | | | |
| I can solve simultaneous equations in two variables by elimination and by substitution, including one linear and one quadratic equation | | | |
| I can solve linear and quadratic inequalities in a single variable and interpret such inequalities graphically, including inequalities with brackets and fractions | | | |
| I can express solutions through correct us of 'and' and 'or' or through set notation | | | |
| I can represent linear and quadratic inequalities graphically | | | |
| I can manipulate polynomial algebraically, including expanding brackets and collecting like terms, factorisation and simple algebraic division; use of the factor theorem | | | |
| I can simplify rational expressions, including by factorising and cancelling, and algebraic division | | | |
| I can understand and use graphs of functions; sketch curves defined by simple equations including polynomials | | | |
| I can understand and use the modulus of a linear function | | | |
| I can interpret algebraic solutions of equations graphically; use intersection points of graphs to solve equations | | | |
| I can understand and use proportional relationships and their graphs | | | |
| I can understand and use composite functions, inverse functions and their graphs | | | |

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| I can understand the effect of simple transformations on the graph $y=f(x)$, including sketching associated graphs | | | |
| I can decompose rational functions into partial fractions | | | |
| I can use functions in modelling including consideration of limitations and refinements of the model | | | |
| I can understand and use the equation of a straight line, including the forms $y-y_1=m(x-x_1)$ and $ax + by + c = 0$ | | | |
| I can understand the gradient conditions for two straight lines to be parallel or perpendicular | | | |
| I can use straight line models in a variety of contexts | | | |
| I can understand and use the coordinate geometry of the circle including using the equation of a circle in the form $(x-a)^2+(y-b)^2=r^2$ | | | |
| I can complete the square to find the centre and radius of a circle and then use the following properties:<br>• The angle in a semicircle is a right angle<br>• The perpendicular from the centre to a chord bisects the chord<br>• The radius of a circle at a given point on its circumference is perpendicular to the tangent to the circle at that point | | | |
| I can understand and use the parametric equations of curves and convert between Cartesian and parametric forms | | | |
| I can use parametric equations in modelling in a variety of contexts | | | |
| I can understand and use the binomial expansion of $(a+bx)^n$ for positive integer n and extend to any rational n, including its use for approximation | | | |
| I can understand and use the definitions of sine, cosine and tangent for all arguments | | | |
| I can understand and use the sine and cosine rules and the area of a triangle formula | | | |
| I can work with radian measure, including use for arc length and area of a sector | | | |
| I can understand and use the standard small angle approximations of sine, cosine and tangent | | | |
| I can understand and use the sine, cosine and tangent functions, their graphs, symmetries and periodicity | | | |
| I can understand and use the definitions of secant, cosecant and cotangent and of arcsin, arccos and arctan; their relationship to sine, cosine and tangent. I can understand their graphs and their ranges and domains | | | |
| I can understand and use trigonometric identities | | | |
| I can understand and use the double angle formulae and the compound angle formulae | | | |
| I can understand geometrical proofs of these formulae | | | |
| I can understand and use expressions for $a\cos x + b\sin x$ in the equivalent forms of $r\cos(x+\alpha)$ or $r\sin(x+\alpha)$ | | | |
| I can solve simple trigonometric equations in a given interval, including quadratic equations in sin, cos and tan and equations involving multiples of the unknown angle | | | |
| I can construct proofs involving trigonometric functions and identities | | | |

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| I can use trigonometric functions to solve problems in context, including problems involving vectors, kinematics and forces | | | |
| I can use the function $a^x$ and its graph, where a is positive | | | |
| I can use the function $e^x$ and its graph | | | |
| I know that the gradient of $e^{kx}$ is equal to $ke^{kx}$ and hence understand why the exponential model is suitable in many applications | | | |
| I know and use the definition of $\log_a x$ as the inverse of $a^x$, where a is positive and $x>0$ | | | |
| I know and use the function ln x and its graph | | | |
| I know and use ln x as the inverse function of $e^x$ | | | |
| I can understand and use the laws of logarithms | | | |
| I can solve equations of the form $a^x=b$ | | | |
| I can use logarithmic graphs to estimate parameters in relationships of the form $y=ax^n$ and $y=kb^x$ | | | |
| I can understand and use exponential growth and decay; use in modelling; with consideration of limitations and refinements of exponential models | | | |
| I can understand the derivate of f(x) as the gradient of the tangent to the 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 | | | |
| I can sketch the gradient function for a given curve | | | |
| I can calculate second derivatives | | | |
| I can use differentiation from first principles for small positive integer powers of x and for sinx and cosx | | | |
| I can understand and use the second derivative as the rate of change of a gradient and connect this to convex and concave sections of curves along with points of inflection | | | |
| I can differentiate $x^n$, for rational values of n, and related constant multiples, sums and differences | | | |
| I can differentiate $e^{kx}$ and $a^{kx}$, sinkx, coskx, tankx and related sums, differences and constant multiples | | | |
| I can understand and use the derivative of ln x | | | |
| I can apply differentiation to find gradients, tangents and normals | | | |
| I can calculate maxima and minima and stationary points | | | |
| I can identify where functions are increasing or decreasing | | | |
| I can differentiate using the product rule, the quotient rule and the chain rule, including problems involving connected rates of change and inverse functions | | | |
| I can differentiate simple functions and relations defined implicitly or parametrically, for first derivative only | | | |
| I can construct simple differential equations in pure mathematics and in context | | | |
| I know and use the fundamental theorem of calculus | | | |
| I can integrate $x^n$ and related sums, differences and constant multiples | | | |
| I can integrate $e^{kx}$, 1/x, sinkx, coskx and related sums, differences and constant multiples | | | |
| I can understand and use numerical integration, including the use of the trapezium rule and estimate the approximate area under a curve | | | |

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| I can evaluate definite integrals, use a definite integral to find the area under a curve and the area between two curves | | | |
| I can understand and use integration as the limit of a sum | | | |
| I can carry out simple cases of integration by substitution and integration by parts and I understand that these methods are the inverse processes of the chain and product rules | | | |
| I can integrate using partial fractions that are linear in the denominator | | | |
| I can evaluate the analytical solution of simple first order differential equations with separable variables, including finding particular solutions | | | |
| I interpret the solution of a differential equation in the context of solving a problem, including identifying limitations of the solution, including links to kinematics | | | |
| I can 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 | | | |
| I can use vectors in two dimensions and in three dimensions | | | |
| I can calculate the magnitude and direction of a vector and convert between component form and magnitude/direction form | | | |
| I can add vectors diagrammatically and perform the algebraic operations of vector addition and multiplication by scalars, and understand their geometrical interpretations | | | |
| I can understand and use position vectors, calculate the distance between two points represented by position vectors | | | |
| I can use vectors to solve problems in pure mathematics and in context | | | |

Statistics

| Topics | Red | Amber | Green |
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| I can understand and use the terms 'population' and 'sample' | | | |
| I can use samples to make informal inferences about the population | | | |
| I can understand and use sampling techniques, including simple random sampling and opportunity sampling | | | |
| I can 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 | | | |
| I can interpret diagrams for single-variable data, including understanding that area in a histogram represents frequency and can connect this to probability distributions | | | |
| I can understand the informal interpretation of correlation | | | |
| I can understand that correlation does not imply causation | | | |
| I can interpret measures of central tendency and variation, extending to standard deviation | | | |
| I can calculate standard deviation, including from summary statistics | | | |
| I can recognise and interpret possible outliers in data sets and statistical diagrams | | | |
| I can select or critique data presentation techniques in the context of a statistical problem | | | |
| I can clean data including dealing with missing data, errors and outliers | | | |
| I can understand and use mutually exclusive and independent events when calculating probabilities | | | |
| I can link this to discrete and continuous distributions | | | |
| I can understand and use conditional probability, including the use of tree diagrams, Venn diagrams and two-way tables | | | |
| I can understand and use the conditional probability formula | | | |
| I can model with probability including critiquing assumptions made and the likely effect of more realistic assumptions | | | |
| I can understand and use simple, discrete probability distributions including binomial distribution, as a model and calculate probabilities using the binomial distribution | | | |
| I can understand and use the Normal distribution as a model and find probabilities using the Normal distribution | | | |
| I can link this to histograms, mean, standard deviation and points of inflection | | | |
| I can link Normal distribution and the binomial distribution | | | |
| I can select an appropriate probability distribution for a context, with appropriate reasoning, including recognising when the binomial or Normal model may not be appropriate | | | |
| I can understand and apply the language of statistical hypothesis testing, developed through a binomial model: null hypothesis, alternative hypothesis, significance level, 2-tail test, critical value, critical region, acceptance region, p-value | | | |
| I can extend this to correlation coefficients as measures of how close data points lie to a straight line | | | |

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| I can interpret a given correlation coefficient using a given p-value or critical value | | | |
| I can conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret the results in context | | | |
| I can understand that a sample is being used to make an inference about the population | | | |
| I can appreciate that the significance level is the probability of incorrectly rejecting the null hypothesis | | | |
| I can conduct a statistical hypothesis test for the mean of a Normal distribution with known, given or assumed variance and interpret the results in context | | | |

Mechanics

| Topics | Red | Amber | Green |
|---|---|---|---|
| I can understand and use fundamental quantities and units in the S.I. system: length, time and mass | | | |
| I can understand and use derived quantities and units: velocity, acceleration, force, weight, moment | | | |
| I can understand and use the language of kinematics, position, displacement, distance travelled, velocity, speed and acceleration | | | |
| I can 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 | | | |
| I can understand, use and derive the formulae for constant acceleration for the motion in a straight line | | | |
| I can extend the formulae for constant acceleration to 2 dimensions using vectors | | | |
| I can use calculus in kinematics for motion in a straight line and can extend this to 2 dimensions using vectors | | | |
| I can model motion under gravity in a vertical plane using vectors | | | |
| I can derive formulae for time of flight, range and greatest height through the path of a projectile | | | |
| I can understand the concept of a force and can understand and use Newton's first law | | | |
| I can understand and use Newton's second law for motion in a straight line and extend to situations where forces need to be resolved | | | |
| I can understand and use weight and motion in a straight line under gravity; gravitational acceleration, and its value in S.I. units to varying degrees of accuracy | | | |
| I can understand and use Newton's third law, equilibrium of forces on a particle and motion in a straight line | | | |
| I can understand and use the addition of forces, resultant forces and dynamics for motion in a plane | | | |
| I can understand and use the model for friction, coefficient of friction, motion of a body on a rough surface, limiting friction and statics | | | |
| I can understand and use moments in simple static contexts | | | |
| I can model motion under gravity relating to projectiles and projectile motion | | | |