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A LEVEL

***MATHEMATICS A***

**H240**

For first teach in 2017­

**Student revision checklist**

Version 1

**Revision checklist**

The tables below can be used as a revision checklist: **It doesn’t contain all the detailed knowledge you need to know, just an overview.** For more detail see the syllabus and talk to your teacher. [A Level Mathematics A H240 specification.](https://www.ocr.org.uk/Images/308723-specification-accredited-a-level-gce-mathematics-a-h240.pdf)

The table headings are explained below:

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| **You should be able to** | **Revision tips and practice materials** | | **R** | **A** | **G** | | | | **Comments** | | | | |
| Here is a list of the skills you need to cover and work on.  Stage 2 topics are shown in the bold lined cells in the first column. | You can use this column to add references for revision practice materials, such as:   * Textbook page references * Teacher worksheets * OCR Section check in tests * MEI Integral exercises, summary sheets, progress tests and topic assessments | | You can use the tick boxes to show when you have revised an item and how confident you feel about it.  R = **RED** means you are really unsure and lack confidence; you might want to focus your revision here and possibly talk to your teacher for help  A = **AMBER** means you are reasonably confident but need some extra practice  G = **GREEN** means you are very confident.  As your revision progresses, you can concentrate on the **RED** and **AMBER** items in order to turn them into **GREEN** items.  You might find it helpful to highlight each topic in red, orange or green to help you prioritise. | | | | | | You can use the comments column to:   * add more information about the details for each point * add formulae or notes * include a reference to a useful resource.   Highlight areas of difficulty or things that you need to talk to your teacher about or look up in a textbook. | | | | |
| **You should be able to**  **(Topics)** | | | **Revision tips and practice materials** | | | | **R** | **A** | | | **G** | | **Comments** | | | |
| **1.01 Proof:** | | | Practise algebraic manipulation and the structuring of a mathematical proof. | | | |  | |  | | |  | |  | |
| a) Understand and be able to use the structure of mathematical proof, proceeding from given assumptions through a series of logical steps to a conclusion. | | |  | | | |  | |  | | |  | |  | |
| b) Understand and be able to use the logical connectives . | | |  | | | |  | |  | | |  | |  | |
| c) Be able to show disproof by counter example. | | |  | | | |  | |  | | |  | |  | |
| d) Understand and be able to use proof by contradiction. | | |  | | | |  | |  | | |  | |  | |
| **1.02 Algebra and Functions:** | | | Practise algebraic manipulation and curve sketching. | | | |  | |  | | |  | |  | |
| a) Understand and be able to use the laws of indices for all rational exponents. | | |  | | | |  | |  | | |  | |  | |
| b) Be able to use and manipulate surds, including rationalising the denominator. | | |  | | | |  | |  | | |  | |  | |

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| d) Be able to work with quadratic functions and their graphs, and the discriminant  (*D* or) |  | |  | |  | |  | | real distinct roots  repeated roots  roots are not real | |
| e) Be able to complete the square of the quadratic polynomial . |  | |  | |  | |  | |  | |
| f) Be able to solve quadratic equations including quadratic equations in a function of the unknown. |  | |  | |  | |  | |  | |
| g) Be able to solve linear and quadratic inequalities in a single variable and interpret such inequalities graphically, including inequalities with brackets and fractions. |  | |  | |  | |  | |  | |
| h) Be able to express solutions through correct use of ‘and’ and ‘or’, or through set notation. |  | |  | |  | |  | |  | |
| i) Be able to represent linear and quadratic inequalities such as  and  graphically. |  | |  | |  | |  | |  | |
| j) Be able to manipulate polynomials algebraically. |  | |  | |  | |  | | is a factor of  is a factor of | |
| k) Be able to simplify rational expressions. |  | |  | |  | |  | |  | |
| **You should be able to**  **(Topics)** | **Revision tips and practice materials** | | **R** | | **A** | | **G** | | **Comments** | |
| l) Understand and be able to use the modulus function, including the notation  , and use relations such as  and  in the course of solving equations and inequalities. |  | |  | |  | |  | |  | |
| m) Understand and be able to use graphs of functions. |  | |  | |  | |  | |  | |
| n) Be able to sketch curves defined by simple equations including polynomials. |  | |  | |  | |  | |  | |
| o) Be able to sketch curves defined by  and  (including their vertical and horizontal asymptotes). |  | |  | |  | |  | |  | |
| p) Be able to interpret the algebraic solution of equations graphically. |  | |  | |  | |  | |  | |
| q) Be able to use intersection points of graphs to solve equations. |  | |  | |  | |  | |  | |
| r) Understand and be able to use proportional relationships and their  graphs. |  | |  | |  | |  | |  | |
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| s) Be able to sketch the graph of the modulus of a linear function involving a single modulus sign. | |  | |  | |  | |  | |  |
| t) Be able to solve graphically simple equations and inequalities involving the modulus function. | |  | |  | |  | |  | |  |
| u) Understand and be able to use the definition of a function. | |  | |  | |  | |  | |  |
| v) Understand and be able to use inverse functions and their graphs, and composite functions. Know the condition for the inverse function to exist and be able to find the inverse of a function either graphically, by reflection in the line , or algebraically. | |  | |  | |  | |  | | *, ,* |
| w) Understand the effect of simple transformations on the graph of  including sketching associated graphs, describing transformations and finding relevant equations: ,*,* and , for any real *a*. | |  | |  | |  | |  | |  |

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| x) Understand the effect of combinations of transformations on the graph of  including sketching associated graphs, describing transformations and finding relevant equations. |  |  |  |  |  |
| y) Be able to decompose rational functions into partial fractions (denominators not more complicated than squared linear terms and with no more than 3 terms, numerators constant or linear). |  |  |  |  |  |
| z) Be able to use functions in modelling. |  |  |  |  |  |
| **1.03 Coordinate Geometry in the *x*-*y* Plane** | Use graphing software to check your understanding of these concepts. |  |  |  |  |
| a) Understand and be able to use the equation of a straight line, including the forms , and . |  |  |  |  |  |
| b) Be able to use the gradient conditions for two straight lines to be parallel or perpendicular. |  |  |  |  | For parallel linesand for perpendicular lines *.* |
| c) Be able to use straight line models in a variety of contexts. |  |  |  |  |  |

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| d) Understand and be able to use the coordinate geometry of a circle including using the equation of a circle in the form . |  |  |  |  |  |
| e) Be able to complete the square to find the centre and radius of a circle. |  |  |  |  |  |
| f) Be able to use the following circle properties in the context of problems in coordinate geometry:  1. the angle in a semicircle is a right angle,  2. the perpendicular from the centre of a circle to a chord bisects the chord,  3. the radius of a circle at a given point on its circumference is perpendicular to the tangent to the circle at that point. |  |  |  |  |  |
| g) Understand and be able to use the parametric equations of curves and be able to convert between cartesian and parametric forms. |  |  |  |  |  |
| h) Be able to use parametric equations in modelling in a variety of contexts. |  |  |  |  |  |

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| **1.04 Sequences and Series** | Practise algebraic manipulation and working with formulae. |  |  |  |  |
| a) Understand and be able to use the binomial expansion of  for positive integer  and the notations  and ,  or , with . |  |  |  |  |  |
| b) Understand and know the link to binomial probabilities. |  |  |  |  |  |
| c) Be able to extend the binomial expansion of  to any rational , including its use for approximation. |  |  |  |  |  |
| d) Know that the expansion is valid for . |  |  |  |  |  |
| e) Be able to work with sequences including those given by a formula for the  term and those generated by a simple relation of the form . |  |  |  |  |  |

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| f) Understand the meaning of and work with increasing sequences, decreasing sequences and periodic sequences. |  |  |  | |  | |  | |
| g) Understand and be able to use sigma notation for sums of series. |  |  |  | |  | |  | |
| h) Understand and be able to work with arithmetic sequences and series, including the formulae for the  term and the sum to terms. |  |  |  |  | | arithmetic progression (AP) | |
| i) Understand and be able to work with geometric sequences and series including the formulae for the  term and the sum of a finite geometric series. |  |  |  |  | |  | |
| j) Understand and be able to work with the sum to infinity of a convergent geometric series, including the use of  and the use of modulus notation in the condition for convergence. |  |  |  |  | | geometric progression (GP) | |
| k) Be able to use sequences and series in modelling. |  |  |  |  | |  | |

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| **1.05 Trigonometry** | | Use drawing and graphing software to check your understanding of these concepts. | |  | |  |  |  |
| a) Understand and be able to use the definitions of sine, cosine and tangent for all arguments. | |  | |  | |  |  |  |
| b) Understand and be able to use the sine and cosine rules. | |  | |  | |  |  |  |
| c) Understand and be able to use the area of a triangle in the form . | |  | |  | |  |  |  |
| d) Be able to work with radian measure, including use for arc length and area of sector. | |  | |  | |  |  | and |
| e) Understand and be able to use the standard small angle approximations of sine, cosine and tangent:  1.,  2.,  3.,  where  is in radians. | |  | |  | |  |  |  |

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| f) Understand and be able to use the sine, cosine and tangent functions, their graphs, symmetries and periodicities. | |  | |  | |  |  | exact values ofand forandforand multiples thereof |
| g) Know and be able to use exact values of and  for  and multiples thereof, and exact values of for  and multiples thereof. | |  | |  | |  |  |  |
| h) Understand and be able to use the definitions of secant (), cosecant  () and cotangent  () and of ,  and  and their relationships to ,  and  respectively. | |  | |  | |  |  |  |
| i) Understand the graphs of the functions given in 1.05h, their ranges and domains. | |  | |  | |  |  | or *,* or  *,* or |
| j) Understand and be able to use  and . | |  | |  | |  |  |  |
| k) Understand and be able to use  and . | |  | |  | |  |  |  |
| **You should be able to**  **(Topics)** | **Revision tips and practice materials** | | **R** | | **A** | | **G** | **Comments** |
| l) Understand and be able to use double angle formulae and the formulae for ,  and . | |  | |  | |  |  |  |
| m) Understand the geometrical proofs of these formulae. | |  | |  | |  |  |  |
| n) Understand and be able to use expressions for  in the equivalent forms of  or . | |  | |  | |  |  |  |
| o) Be able to solve simple trigonometric equations in a given interval, including quadratic equations in ,  and  and equations involving multiples of the unknown angle. | |  | |  | |  |  |  |
| p) Be able to construct proofs involving trigonometric functions and identities. | |  | |  | |  |  |  |
| q) Be able to use trigonometric functions to solve problems in context, including problems involving vectors, kinematics and forces. | |  | |  | |  |  |  |

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| **1.06 Exponentials and Logarithms** | Practise algebraic manipulation and use graphing software to check your understanding of these concepts. | |  |  |  |  |
| a) Know and use the functionand its graph, where  is positive.  Know and use the functionand its graph. |  | |  |  |  |  |
| b) Know that the gradient of  is equal to  and hence understand why the exponential model is suitable in many applications. |  | |  |  |  |  |
| c) Know and use the definition of  (for ) as the inverse of (for all ), where is positive. |  | |  |  |  | and |
| d) Know and use the function  and its graph. |  |  | |  |  |  | |
| e) Know and use  as the inverse function of . |  |  | |  |  | and | |

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| f) Understand and be able to use the laws of logarithms:  1.  2.  3.  (including, for example,  and ). | | |  |  | | |  |  |  | | |
| g) Be able to solve equations of the form  for | | |  |  | | |  |  |  | | |
| h) Be able to use logarithmic graphs to estimate parameters in relationships of the form  and , given data for  and *.* | | |  |  | | |  |  |  | | |
| i) Understand and be able to use exponential growth and decay and use the exponential function in modelling. | | |  |  | | |  |  |  | | |
| **1.07 Differentiation** | | | Use graphing software and calculator functions to check answers and your understanding of these concepts. |  | | |  |  |  | | |
| a) Understand and be able to use the derivative of  as the gradient of the tangent to the graph of  at a general point . | | |  |  | | |  |  |  | | |
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| b) Understand and be able to use the gradient of the tangent at a point where  as:  1. the limit of the gradient of a chord as  tends to  2. a rate of change of  with respect to*.* |  | | |  | |  | |  | and |
| c) Understand and be able to sketch the gradient function for a given curve. |  | | |  | |  | |  |  |
| d) Understand and be able to find second derivatives. |  | | |  | |  | |  | and |
| e) Understand and be able to use the second derivative as the rate of change of gradient. |  | | |  | |  | |  |  |
| f) Understand and be able to use the second derivative in connection to convex and concave sections of curves and points of inflection. |  | | |  | |  | |  | 1. ifon an interval, the function is convex in that interval;  2. ifon an interval the function is concave in that interval;  3. ifand the curve changes from concave to convex or vice versa there is a point of inflection. |

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| g) Be able to show differentiation from first principles for small positive integer powers of . |  | | |  | | |  | | |  | | *i* |
| h) Be able to show differentiation from first principles for  and . | | |  | | |  | | |  |  | |  |
| i) Be able to differentiate *,* for rational values of *n*, and related constant multiples, sums and differences. | | |  | | |  | | |  |  | |  |
| j) Be able to differentiate  and , and related sums, differences and constant multiples. | | |  | | |  | | |  |  | |  |
| k) Be able to differentiate , ,  and related sums, differences and constant multiples. | | |  | | |  | | |  |  | |  |
| l) Understand and be able to use the derivative of . | | |  | | |  | | |  |  | |  |
| m) Be able to apply differentiation to find the gradient at a point on a curve and the equations of tangents and normals to a curve. | | |  | | |  | | |  |  | |  |
| n) Be able to apply differentiation to find and classify stationary points on a curve as either maxima or minima. | | |  | | |  | | |  |  | |  |
| **You should be able to**  **(Topics)** | | | **Revision tips and practice materials** | | | **R** | | | **A** | | **G** | **Comments** |
| o) Be able to identify where functions are increasing or decreasing. | | |  | | |  | | |  |  | |  |
| p) Be able to apply differentiation to find points of inflection on a curve. | | |  | | |  | | |  |  | |  |
| q) Be able to differentiate using the product rule and the quotient rule. | | |  | | |  | | |  |  | | and |
| r) Be able to differentiate using the chain rule, including problems involving connected rates of change and inverse functions. | | |  | | |  | | |  |  | |  |
| s) Be able to differentiate simple functions and relations defined implicitly or parametrically for the first derivative only. | | |  | | |  | | |  |  | |  |
| t) Be able to construct simple differential equations in pure mathematics and in context (contexts may include kinematics, population growth and modelling the relationship between price and demand). | | |  | | |  | | |  |  | |  |

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| **1.08 Integration** | Use graphing software and calculator functions to check answers and your understanding of these concepts. |  |  |  | |  |
| a) Know and be able to use the fundamental theorem of calculus. |  |  |  |  | |  |
| b) Be able to integrate  where  and related sums, differences and constant multiples. |  |  |  |  | |  |
| c) Be able to integrate , , ,  and related sums, differences and constant multiples. |  |  |  |  | |  |
| d) Be able to evaluate definite integrals. |  |  |  |  | |  |
| e) Be able to use a definite integral to find the area between a curve and the *x*-axis. |  |  |  |  | |  |
| f) Be able to use a definite integral to find the area between two curves. |  |  |  | |  |  |
| g) Understand and be able to use integration as the limit of a sum. |  |  |  | |  |  |
| h) Be able to carry out simple cases of integration by substitution. |  |  |  | |  |  |

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| i) Be able to carry out simple cases of integration by parts. |  | |  | |  | |  | |  |
| j) Be able to integrate functions using partial fractions that have linear terms in the denominator. |  | |  | |  | |  | |  |
| k) Be able to evaluate the analytical solution of simple first order differential equations with separable variables, including finding particular solutions. |  | |  | |  | |  | |  |
| l) Be able to interpret the solution of a differential equation in the context of solving a problem, including identifying limitations of the solution. |  | |  | |  | |  | |  |
| **1.09 Numerical Methods** | Use spreadsheets and calculator functions to check answers and your understanding of these concepts. | |  | |  | |  | |  |
| a) Be able to locate roots of  by considering changes of sign of  in an interval of  on which  is sufficiently well-behaved. |  | |  | |  | |  | |  |
| b) Understand how change of sign methods can fail. |  | |  | |  | |  | |  |

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| c) Be able to solve equations approximately using simple iterative methods and be able to draw associated cobweb and staircase diagrams. |  | |  | |  | |  | |  |
| d) Be able to solve equations using the Newton-Raphson method and other recurrence relations of the form . |  | |  | |  | |  | |  |
| e) Understand and be able to show how such methods can fail. |  | |  | |  | |  | | 1. the iterationconverges to a root atif *,* and if is sufficiently close to *;*  2. the Newton-Raphson method will fail if the initial value coincides with a stationary point. |
| f) Understand and be able to use numerical integration of functions, including the use of the trapezium rule, and estimating the approximate area under a curve and the limits that it must lie between. |  | |  | |  | |  | |  |
| g) Be able to use numerical methods to solve problems in context. |  | |  | |  | |  | |  |

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| **1.10 Vectors** | Practise drawing diagrams to help aid understanding. |  |  |  |  |
| a) Be able to use vectors in two dimensions. |  |  |  |  | or as a column vector  or |
| b) Be able to use vectors in three dimensions. |  |  |  |  |  |
| c) Be able to calculate the magnitude and direction of a vector and convert between component form and magnitude/direction form. |  |  |  |  | for the magnitude ofand for the magnitude of  magnitude of a vectoras and its direction by |
| d) Be able to add vectors diagrammatically and perform the algebraic operations of vector addition and multiplication by scalars and understand their geometrical interpretations. |  |  |  |  |  |
| e) Understand and be able to use position vectors. |  |  |  |  |  |

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| f) Be able to calculate the distance between two points represented by position vectors. | |  | |  | |  |  | The distance between the points and is |
| g) Be able to use vectors to solve problems in pure mathematics and in context, including forces. | |  | |  | |  |  |  |
| h) Be able to use vectors to solve problems in kinematics. | |  | |  | |  |  |  |
| **2.01 Statistical Sampling** | | Use the LDS to practise taking representative and biased samples. | |  | |  |  |  |
| a) Understand and be able to use the terms ‘population’ and ‘sample’. | |  | |  | |  |  |  |
| b) Be able to use samples to make informal inferences about the population. | |  | |  | |  |  |  |
| c) Understand and be able to use sampling techniques, including simple random sampling and opportunity sampling. | |  | |  | |  |  |  |
| d) Be able to 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. | |  | |  | |  |  |  |
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| **2.02 Data Presentation and Interpretation** | | Investigate different features of the LDS using graphs and statistical calculations.  Use spreadsheets to analyse the data and create statistical diagrams. | |  | |  |  |  |
| a) Be able to interpret tables and diagrams for single-variable data. | |  | |  | |  |  |  |
| b) Understand that area in a histogram represents frequency. | |  | |  | |  |  |  |
| c) Be able to interpret scatter diagrams and regression lines for bivariate data, including recognition of scatter diagrams which include distinct sections of the population. | |  | |  | |  |  |  |
| d) Be able to understand informal interpretation of correlation. | |  | |  | |  |  |  |
| e) Be able to understand that correlation does not imply causation. | |  | |  | |  |  |  |
| f) Be able to calculate and interpret measures of central tendency and variation, including mean, median, mode, percentile, quartile, inter-quartile range, standard deviation and variance. | |  | |  | |  |  |  |

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| g) Be able to calculate mean and standard deviation from a list of data, from summary statistics or from a frequency distribution, using calculator statistical functions. |  | |  | |  |  | formulae for standard deviation:  *,* |
| h) Recognise and be able to interpret possible outliers in data sets and statistical diagrams. |  | |  | |  |  |  |
| i) Be able to select or critique data presentation techniques in the context of a statistical problem. |  | |  | |  |  |  |
| j) Be able to clean data, including dealing with missing data, errors and outliers. |  | |  | |  |  | definitions of outliers:  1. more than 1.5 × (interquartile range) from the nearer quartile  2. more than 2 × (standard deviation) away from the mean |
| **2.03 Probability** | Conduct mini-experiments using the random number generator function in spreadsheets. | |  | |  |  |  |
| a) Understand and be able to use mutually exclusive and independent events when calculating probabilities. |  | |  | |  |  | , , , |
| b) Be able to use appropriate diagrams to assist in the calculation of probabilities. |  | |  | |  |  |  |
| **You should be able to**  **(Topics)** | **Revision tips and practice materials** | | **R** | | **A** | **G** | **Comments** |
| c) Understand and be able to use conditional probability, including the use of tree diagrams, Venn diagrams and two-way tables. |  | |  | |  |  | *, ,*  *,* |
| d) Understand the concept of conditional probability and calculate it from first principles in given contexts. |  | |  | |  |  |  |
| e) Be able to model with probability, including critiquing assumptions made and the likely effect of more realistic assumptions. |  | |  | |  |  |  |
| **2.04 Statistical Distributions** | Conduct mini-experiments using the random number generator function in spreadsheets. |  | | |  |  |  |
| a) Understand and be able to use simple, finite, discrete probability distributions, defined in the form of a table or a formula such as:  for . |  |  | | |  |  |  |
| b) Understand and be able to use the binomial distribution as a model. |  |  | | |  |  |  |

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| **You should be able to**  **(Topics)** | **Revision tips and practice materials** | | **R** | | **A** | | **G** | **Comments** | |
| c) Be able to calculate probabilities using the binomial distribution, using appropriate calculator functions. |  | |  | |  | |  |  | |
| d) Know and be able to use the formulae  and  when choosing a particular normal model to use as an approximation to a binomial model. |  | |  | |  | |  |  | |
| e) Understand and be able to use the normal distribution as a model. |  | |  | |  | |  |  | |
| f) Be able to find probabilities using the normal distribution, using appropriate calculator functions. |  | |  | |  | |  |  | |
| g) Understand links to histograms, mean and standard deviation. | |  | |  | |  |  | 1. about two-thirds of values lie in the range *,*  2. about 95% of values lie in the range *,*  3. almost all values lie in the rangeand  4. the points of inflection in a normal curve occur at |

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| **You should be able to**  **(Topics)** | **Revision tips and practice materials** | **R** | **A** | **G** | **Comments** |
| h) Be able to select an appropriate probability distribution for a context, with appropriate reasoning, including recognising when the binomial or normal model may not be appropriate. |  |  |  |  |  |
| **2.05 Statistical Hypothesis Testing** | Practise setting out questions; state the hypotheses, test and conclude. |  |  |  |  |
| a) Understand and be able to use 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. |  |  |  |  | Hypotheses should be stated in terms of parameter values (where relevant) and the meanings of symbols should be stated. For example,  *“**,,* where *is* the population proportion in favour of the resolution”.  Conclusions should be stated in such a way as to reflect the fact that they are not certain. For example,  "There is evidence at the 5% level to reject *.* It is likely that the mean mass is less than 500 g." |
| b) Be able to conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret the results in context. |  |  |  |  |  |

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| **You should be able to**  **(Topics)** | **Revision tips and practice materials** | | **R** | | **A** | | **G** | **Comments** |
| c) 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. | |  | |  | |  |  |  |
| d) Recognise that a sample mean, , can be regarded as a random variable. | |  | |  | |  |  | if then |
| e) Be able to conduct a statistical hypothesis test for the mean of a normal distribution with known, given or assumed variance and interpret the results in context. | |  | |  | |  |  |  |
| f) Understand Pearson's product-moment correlation coefficient as a measure of how close data points lie to a straight line. | |  | |  | |  |  |  |
| g) Use and be able to interpret Pearson's product-moment correlation coefficient in hypothesis tests, using either a given critical value or a *p-*value and a table of critical values. | |  | |  | |  |  |  |

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| **You should be able to**  **(Topics)** | **Revision tips and practice materials** | **R** | **A** | **G** | **Comments** |
| **3.01 Quantities and Units in Mechanics** | Learn the definitions and units. |  |  |  |  |
| a) Understand and be able to use the fundamental quantities and units in the S.I. system: length (in metres), time (in seconds), mass (in kilograms). |  |  |  |  |  |
| b) Understand and be able to use derived quantities and units: velocity (m/s or m s-1), acceleration (m/s2 or m s-2), force (N), weight (N). |  |  |  |  |  |
| c) Understand and be able to use the unit for moment (N m). |  |  |  |  |  |
| **3.02 Kinematics** | Conduct real and virtual experiments to help aid understanding. |  |  |  |  |
| a) Understand and be able to use the language of kinematics: position, displacement, distance, distance travelled, velocity, speed, acceleration, equation of motion. |  |  |  |  |  |
| b) Understand, use and interpret graphs in kinematics for motion in a straight line. |  |  |  |  |  |

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| **You should be able to**  **(Topics)** | **Revision tips and practice materials** | **R** | **A** | **G** | **Comments** |
| c) Be able to interpret displacement-time and velocity-time graphs, and in particular understand and be able to use the facts that the gradient of a displacement-time graph represents the velocity, the gradient of a velocity-time graph represents the acceleration, and the area between the graph and the time axis for a velocity-time graph represents the displacement. |  |  |  |  |  |
| d) Understand, use and derive the formulae for constant acceleration for motion in a straight line: |  |  |  |  |  |

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| **You should be able to**  **(Topics)** | **Revision tips and practice materials** | **R** | **A** | **G** | **Comments** |
| e) Be able to extend the constant acceleration formulae to motion in two dimensions using vctors: |  |  |  |  |  |
| f) Be able to use differentiation and integration with respect to time in one dimension to solve simple problems concerning the displacement, velocity and acceleration of a particle:      and |  |  |  |  |  |

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| **You should be able to**  **(Topics)** | | **Revision tips and practice materials** | | **R** | | **A** | **G** | **Comments** |
| g) Be able to extend the application of differentiation and integration to two dimensions using vectors:        and | |  | |  | |  |  |  |
| h) Be able to model motion under gravity in a vertical plane using vectors where  or . |  | |  | |  | |  |  |
| i) Be able to model the motion of a projectile as a particle moving with constant acceleration and understand the limitation of this model. |  | |  | |  | |  |  |

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| **You should be able to**  **(Topics)** | **Revision tips and practice materials** | **R** | **A** | **G** | **Comments** |
| **3.03 Forces and Newton’s laws** | Conduct real and virtual experiments to help aid understanding. |  |  |  |  |
| a) Understand the concept and vector nature of a force. |  |  |  |  |  |
| b) Understand and be able to use Newton’s first law. |  |  |  |  |  |
| c) Understand and be able to use Newton’s second law () for motion in a straight line for bodies of constant mass moving under the action of constant forces. |  |  |  |  |  |
| d) Understand and be able to use Newton’s second law () in simple cases of forces given as two dimensional vectors. |  |  |  |  |  |
| e) Be able to extend use of Newton’s second law to situations where forces need to be resolved (restricted to two dimensions). |  |  |  |  |  |
| f) Understand and be able to use the weight () of a body to model the motion in a straight line under gravity. |  |  |  |  |  |

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| **You should be able to**  **(Topics)** | **Revision tips and practice materials** | | **R** | | **A** | | **G** | **Comments** |
| g) Understand the gravitational acceleration, *g*, and its value in S.I. units to varying degrees of accuracy. | |  | |  | |  |  | The value of *g* may be assumed to take a constant value of9.8 ms-2 |
| h) Understand and be able to use Newton’s third law. | |  | |  | |  |  |  |
| i) Understand and be able to use the concept of a normal reaction force. | |  | |  | |  |  |  |
| j) Be able to use the model of a ‘smooth’ contact and understand the limitations of the model. | |  | |  | |  |  |  |
| k) Be able to use the concept of equilibrium together with one dimensional motion in a straight line to solve problems that involve connected particles and smooth pulleys. | |  | |  | |  |  |  |
| l) Be able to extend use of Newton’s third law to situations where forces need to be resolved (restricted to two dimensions). | |  | |  | |  |  |  |

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| **You should be able to**  **(Topics)** | **Revision tips and practice materials** | | | **R** | | | **A** | | | **G** | **Comments** |
| m) Be able to use the principle that a particle is in equilibrium if and only if the sum of the resolved parts in a given direction is zero. | |  | | |  | | |  | |  |  |
| n) Be able to solve problems involving simple cases of equilibrium of forces on a particle in two dimensions using vectors, including connected particles and smooth pulleys. | |  | | |  | | |  | |  |  |
| o) Be able to resolve forces for more advanced problems involving connected particles and smooth pulleys. | |  | | |  | | |  | |  |  |
| p) Understand the term ‘resultant’ as applied to two or more forces acting at a point and be able to use vector addition in solving problems involving resultants and components of forces. | |  | | |  | | |  | |  |  |
| q) Be able to solve problems involving the dynamics of motion for a particle moving in a plane under the action of a force or forces. | |  | | |  | | |  | |  |  |
| r) Understand the concept of a frictional force and be able to apply it in contexts where the force is given in vector or component form, or the magnitude and direction of the force are given. | |  | | |  | | |  | |  |  |
| **You should be able to**  **(Topics)** | | **Revision tips and practice materials** | | | **R** | | | **A** | | **G** | **Comments** |
| s) Be able to represent the contact force between two rough surfaces by two components (the ‘normal’ contact force and the ‘frictional’ contact force). | |  | | |  | | |  | |  |  |
| t) Understand and be able to use the coefficient of friction and the  model of friction in one and two dimensions, including the concept of limiting friction. | | |  | | |  | | |  |  |  |
| u) Understand and be able to solve problems regarding the static equilibrium of a body on a rough surface and solve problems regarding limiting equilibrium. | | |  | | |  | | |  |  |  |
| v) Understand and be able to solve problems regarding the motion of a body on a rough surface. | | |  | | |  | | |  |  |  |

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| **You should be able to**  **(Topics)** | **Revision tips and practice materials** | | **R** | | **A** | | **G** | **Comments** |
| **3.04 Moments** | | Conduct real and virtual experiments to help aid understanding. | |  | |  |  |  |
| a) Be able to calculate the moment of a force about an axis through a point in the plane of the body. | |  | |  | |  |  |  |
| b) Understand that when a rigid body is in equilibrium the resultant moment is zero and the resultant force is zero. | |  | |  | |  |  |  |
| c) Be able to use moments in simple static contexts. | |  | |  | |  |  |  |

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| **You should be able to**  **(Assessment Objectives)** | **Revision tips and practice materials** | **R** | **A** | **G** | **Comments** |
| AO1.1a Select routine procedures | Read exam questions carefully to identify the topics being assessed. |  |  |  |  |
| AO1.1b Correctly carry out routine procedures | Practise the questions that appear at the start of each exercise in the textbook as these will be more procedural. |  |  |  |  |
| AO1.2 Accurately recall facts, terminology and definitions | Produce your own glossary of mathematical facts and definitions. |  |  |  |  |
| AO2.1 Construct rigorous mathematical arguments (including proofs) | Set out your work neatly and avoid missing out logical steps in your working. |  |  |  |  |
| AO2.2a Make deductions from known results to correct conclusions | Always link the calculated answer back to the context given in the question. |  |  |  |  |
| AO2.2b Make inferences from relative or partial evidence to results that are likely to be correct | Always consider what your answer means in real life and how the answer should be interpreted in the context given in the question. |  |  |  |  |

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| **You should be able to**  **(Assessment Objectives)** | **Revision tips and practice materials** | **R** | **A** | **G** | **Comments** |
| AO2.3 Assess the validity of mathematical arguments by identifying any errors/omissions or by finding the conditions under which the argument remains correct | Check that your answer makes sense and consider when other factors may negate that answer. |  |  |  |  |
| AO2.4 Explain the reasoning by providing justification for key steps | Set out work neatly, showing each of the required steps in the calculation to justify your answer. |  |  |  |  |
| AO2.5 Use mathematical language and notation correctly | Only use accepted abbreviations and notations. These are listed in section 5c of the specification. |  |  |  |  |

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| **You should be able to**  **(Assessment Objectives)** | **Revision tips and practice materials** | **R** | **A** | **G** | **Comments** |
| AO3.1a Translate problems in mathematical contexts into mathematical processes | Read exam questions carefully to identify the topics being assessed.  Practise the questions that appear at the end of each exercise in the textbook as these will be more rigorous. |  |  |  |  |
| AO3.1b Translate problems in non-mathematical contexts into mathematical processes | Read exam questions carefully to identify the topics being assessed.  Practise the questions that appear at the end of each exercise in the textbook as these will be more rigorous. |  |  |  |  |
| AO3.2a Interpret solutions to problems in their original context | State your answer in the context given in the question. |  |  |  |  |
| AO3.2b Evaluate the accuracy and limitations of any solutions | Check that your answer makes sense in the context of the question and consider when other factors may negate that answer. |  |  |  |  |

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| **You should be able to**  **(Assessment Objectives)** | **Revision tips and practice materials** | **R** | **A** | **G** | **Comments** |
| AO3.3 Translate situations in context into mathematical models | Read exam questions carefully to identify the topics being assessed. |  |  |  |  |
| AO3.4 Use mathematical models | Practise all of the mathematical models defined in the specification. |  |  |  |  |
| AO3.5a Evaluate the outcomes of modelling in context | Check that your answer makes sense in the context of the question and consider when other factors may negate that answer. |  |  |  |  |
| AO3.5b Recognise the limitations of models | Consider the assumptions used when using any mathematical model. |  |  |  |  |
| AO3.5c Explain how a model could be refined (improved) | State your answer in the context given in the question. |  |  |  |  |

**You must be able to use the following formulae and identities for A Level mathematics, without these formulae and identities being provided, either in these forms or in equivalent forms. These formulae and identities may only be provided where they are the starting point for a proof or as a result to be proved.**

**Pure Mathematics**  
  
**Quadratic Equations**



**Laws of Indices**

**Laws of Logarithms**

 for  and 



**Coordinate Geometry**

A straight line graph, gradient *m* passing through  has equation



Straight lines with gradients  and  are perpendicular when 

**Sequences**

General term of an arithmetic progression:

General term of a geometric progression:

**Trigonometry**

In the triangle ABC

Sine rule: 

Cosine rule: 

Area

   
   


   




**Mensuration**Circumference and Area of circle, radius *r* and diameter *d*:

****

Pythagoras’ Theorem: In any right-angled triangle where *a*, *b* and *c* are the lengths of the sides and *c* is the hypotenuse:



Area of a trapezium = ****, where *a* and *b* are the lengths of the parallel sides and *h* is their perpendicular separation.  
  
Volume of a prism = area of cross section × length

For a circle of radius *r*, where an angle at the centre of *θ* radians subtends an arc of length *s* and encloses an associated sector of area *A*:   
  


**Calculus and Differential Equations**

Differentiation

FunctionDerivative

    
    
    
    
    
    
    
 

Integration

FunctionIntegral

    
    
    
    
    
    
 

Area under a curve  **Vectors  
  
**

**Mechanics**

**Forces and Equilibrium**

Weight = mass 

Friction: 

Newton’s second law in the form: 

**Kinematics**

For motion in a straight line with variable acceleration:









**Statistics**

The mean of a set of data: 

The standard Normal variable: where 

You will be given the following formulae sheet in each question paper.

**Arithmetic series  
**

**Geometric series  
  
**

**Binomial series  
**,where **  
**

**Differentiation**

|  |  |
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Quotient Rule ****, ****

**Differentiation from first principles  
**

**Integration  
**

****

Integration by parts ****

**Small angle approximations  
**where *θ* is measured in radians

**Trigonometric identities**

  
  


**Numerical methods**  
Trapezium rule: …}, where   
The Newton-Raphson iteration for solving : 

**Probability  
  
 or **

**Standard deviation**

 **or** 

**The binomial distribution**Ifthen, Mean of *X* is *np,* Variance of *X* is *np*(1 – *p*)

**Hypothesis test for the mean of a normal distribution**If then and

**Percentage points of the normal distribution**

If *Z* has a normal distribution with mean 0 and variance 1 then, for each value of *p*, the table gives the value of *z* such that 

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *p* | 0.75 | 0.90 | 0.95 | 0.975 | 0.99 | 0.995 | 0.9975 | 0.999 | 0.9995 |
| *z* | 0.674 | 1.282 | 1.645 | 1.960 | 2.326 | 2.575 | 2.807 | 3.090 | 3.291 |

**Kinematics**

|  |  |
| --- | --- |
| Motion in a straight line | Motion in two dimensions |
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