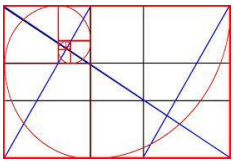
Name_____

September 2021

Year 12 Mathematics Handbook



'It is not enough to have a good mind. The main thing is to use it well.' ~ Rene Descartes

Specification and Assessment

The specification is Pearson Edexcel Level 3 Advanced GCE in Mathematics (9MA0). All external exams will be sat at the end of Year 13. Calculators are allowed in all exams and a formula sheet will be provided.

Paper 1	Pure Mathematics	100 marks	Duration: 2 hours
Paper 2	Pure Mathematics	100 marks	Duration: 2 hours
Paper 2	Statistics and Mechanics	100 marks	Duration: 2 hours

You will have four sets of internal pre-public examinations during the two year course.

Folders, Equipment and Presentation

You will bring your maths folder to every lesson. Use file dividers to separate chapters. Keep your notes neat and well organised. Your folder should contain classwork (notes, examples and practice questions), independent work and assessments. All work should be well presented. Work in pen (except when drawing graphs), show workings, cross through mistakes neatly, number questions and underline final answers.

You will be expected to provide your own stationery in every lesson:

Pen, pencil and ruler	Folder and paper (lines, plain or grid)
Green pen for marking your own work	Scientific calculator **(Casio fx-991EX Classwiz)**

Resources

Textbooks*:	Edexcel AS and A level Mathematics Pure Mathematics Year 1/AS Textbook Pearson. ISBN-13: 9781292183398.
	Edexcel AS and A level Mathematics Statistics & Mechanics Year 1/AS Textbook Pearson. ISBN-13: 9781292183282.
Practice papers:	physicsandmathstutor.com madasmaths.com
Videos:	examsolutions.net

Most materials designed for previous A level specifications continue to be useful.

Information about revision guides and revision courses will be made available in due course.

*Year 12 content only

Private Study

It is vital that you spend as much time as possible practising mathematics, right from the start of the course. There should **never** be a time that you sit in private study and say you haven't been set any maths. You **always** have maths to do.

Sometimes you will be set an assignment - this must be completed by the deadline. If you are not set an assignment, you must do independent practice by: completing unfinished classwork / completing and marking extra exercises / doing practice exam papers.

Support

Speak to or email your teacher to ask for help. An after school drop-in clinic is also available.

Please visit glynmaths.blogspot.co.uk to access exercises for independent study, links to useful websites, specification information and enrichment ideas.

Homeworks and Assessments Log

Date	Topic/Title	Grade	Feedback	Actions

How to Read A Level Maths Mark Schemes

If you do a past paper question and want to check your solutions, you might find the mark scheme confusing. This guide should help you make sense of it.

M marks: *method* marks are awarded for *knowing a method and attempting to apply it*.
A marks: *accuracy* marks can only be awarded if the relevant method (M) marks have been earned.
B marks are unconditional accuracy marks (independent of M marks).

Abbreviations

- bod – benefit of doubt
- ft – follow through
- the symbol √ will be used for correct ft
- cao – correct answer only
- cso – correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp – decimal places
- sf – significant figures
- * The answer is printed on the paper (eg in a *show that* question)
- [The second mark is dependent on gaining the first mark

Exam Tips

- State each formula you need before attempting to use it
- Write each step on a new line
- If a question has several parts (a) (b) etc:
    - label each part clearly
    - leave gaps between your answers to each part
    - your answer to one part may well help you do the next part
    - if you can not do part (a) of a question, try part (b)
- Give answers to an appropriate accuracy (if final answer is to 3sf then do all intermediate working to at least 4sf)
- If you have two attempts at a question decide which one you want marked and cross out the other one with a single diagonal line
- If the final answer has a unit (eg cm) then include it
- If you are stuck, try drawing a diagram or sketching a graph.

Wording of Exam Questions

Write down, state: answer should be fairly obvious – little or no work will be needed

Find, Determine, Obtain, Calculate: Some work will be needed, and you will need to show your method

Evaluate: Work out the value of an expression

Verify: You are given the answer – you just have to show that it works

Show that: You have to work out the answer as if it had not been given in the question. You are given the answer because you may need it in the next part of the question.

Prove: A formal proof is required – each line of you answer must follow on logically from the previous line

Explain: This involves writing words (preferably in sentences!)

Interpret: Make a comment that refers to the context of the question

Exact: Not a decimal but a surd, fraction, π etc.

Hence / Hence or otherwise: Hence means you must use the last part of the question to do the next part. Hence or otherwise means you can use the last part of the question to do the next part (usually a good idea!) but don't have to.

Sketch: Use pencil – don't use graph paper – label the axes – if there are two graphs, label each one

In terms of: This usually means that your answer will not be a number but a mathematical expression including one or more letters.

Give your answer in simplified surd form: Simplified surd form means $a \pm b\sqrt{c}$. Bear in mind that c has to be as small as possible so take any square factors out of the root.

Greek Letters

A guide to pronouncing Greek letters commonly used in A Level Maths

α alpha	β beta	μ mu
λ lambda	σ sigma (lower case)	Σ sigma (upper case)
π pi	δ delta (lower case)	Δ delta (upper case)
θ theta	φ phi (lower case)	Φ phi (upper case)

Year 12 Checklist

Topic	Content	✓
Pure Mathematics		
Proof	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 proof by deduction, proof by exhaustion.	
	Disproof by counter example.	
Algebra and functions	Understand and use the laws of indices for all rational exponents.	
	Use and manipulate surds, including rationalising the denominator.	
	Work with quadratic functions and their graphs; the discriminant of a quadratic function, including the conditions for real and repeated roots; completing the square; solution of quadratic equations including solving quadratic equations in a function of the unknown.	
	Solve simultaneous equations in two variables by elimination and by substitution, including one linear and one quadratic equation.	
	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.	
	Represent linear and quadratic inequalities such as $y>x+1$ and $y>ax^2 +bx + c$ graphically.	
	Manipulate polynomials algebraically, including expanding brackets and collecting like terms, factorisation and simple algebraic division; use of the factor theorem.	
	Understand and use graphs of functions; sketch curves defined by simple equations including polynomials, y = a/x and y = a/x2 (including their vertical and horizontal asymptotes); interpret algebraic solution of equations graphically; use intersection points of graphs to solve equations.	
	Understand and use proportional relationships and their graphs.	
	Understand the effect of simple transformations on the graph of y = f(x) including sketching associated graphs: y = af(x), y = f(x) + a, y =f(x+a) and y=f(ax).	
Coordinate geometry in the (x,y) plane	Understand and use the equation of a straight line, including the forms y - y1 = m(x-x1) and ax + by + c = 0; gradient conditions for two straight lines to be parallel or perpendicular.	
	Be able to use straight line models in a variety of contexts.	
	Understand and use the coordinate geometry of the circle including using the equation of a circle in the form $(x-a)^2+(y-b)^2 = r^2$; 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.	
Sequences and series	Understand and use the binomial expansion of $(a+bx)^n$ for positive integer n; the notations n! and ${}^nC_r$; link to binomial probabilities.	
Trigonometry	Understand and use the definitions of sine, cosine and tangent for all arguments; the sine and cosine rules; the area of a triangle in the form (1/2)(a)(b)sinC	
	Understand and use the sine, cosine and tangent functions; their graphs, symmetries and periodicity.	
	Understand and use $\tan\theta = \sin\theta/\cos\theta$	
	Understand and use $(\sin\theta)^2 + (\cos\theta)^2 = 1$;	
	Solve simple trigonometric equations in a given interval, including quadratic equations in sin, cos and tan and equations involving multiples of the unknown angle.	

Exponentials and logarithms	Know and use the function a^x and its graph, where a is positive.	
	Know and use the function e^x and its graph.	
	Know that the gradient of e^{kx} is equal to ke^{kx} and hence understand why the exponential model is suitable in many applications.	
	Know and use the definition of logax as the inverse of a^x, where a is positive and x≥0.	
	Know and use the function lnx and its graph.	
	Know and use lnx as the inverse function of e^x.	
	Understand and use the laws of logarithms: $\log_a(x) + \log_a(y) = \log_a(xy)$, $\log_a(x) - \log_a(y) = \log_a(x/y)$, $k\log_a(x) = \log_a(x^k)$ including k = -1 and k = -(1/2).	
	Solve equations of the form $a^x=b$.	
	Use logarithmic graphs to estimate parameters in relationships of the form $y=ax^n$ and $y = kb^x$, given data for x and y.	
	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.	
Differentiation	Understand and use the derivative 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; sketching the gradient function for a given curve; second derivatives; differentiation from first principles for small positive integer powers of x.	
	Understand and use the second derivative as the rate of change of gradient;	
	Apply differentiation to find gradients, tangents and normals, maxima and minima and stationary points, points of inflection.	
	Identify where functions are increasing or decreasing.	
Integration	Know and use the Fundamental Theorem of Calculus.	
	Integrate x^n (excluding n = -1), and related sums, differences and constant multiples.	
	Evaluate definite integrals; use a definite integral to find the area under a curve.	
Vectors	Use vectors in two dimensions.	
	Calculate the magnitude and direction of a vector and 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.	
	Understand and use position vectors; calculate the distance between two points represented by position vectors.	
	Use vectors to solve problems in pure mathematics and in context, including forces and kinematics.	
Applied Mathematics		
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.	

Data presentation and interpretation	Interpret diagrams for single-variable data, including understanding that area in a histogram represents frequency.	
	Connect 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.	
	Understand 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.	
Probability	Understand and use mutually exclusive and independent events when calculating probabilities.	
	Link to discrete and continuous distributions.	
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.	
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.	
	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.	
Quantities & units	Understand and use fundamental quantities and units in the S.I. system: length, time, mass.	
	Understand and use derived quantities and units: velocity, acceleration, force, weight.	
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.	
	Use calculus in kinematics for motion in a straight line: $v=dr/dt$, $a = dv/dt = d^2r/dt^2$, $r=\int v\, dt$, $v = \int a\, dt$.	
Forces and 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 2-D vectors).	
	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.	
	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 2-D vectors); application to problems involving smooth pulleys and connected particles.	