
A LEVEL: Edexcel Mathematics

TOPICS FOR AUTOGRAPH

References to

[Pearson-Edexcel A level Mathematics](#)

Papers 1 and 2: PURE MATHEMATICS

ALGEBRA

- 2.3 Quadratic $ax^2 + bx + c = 0$
Discriminant $b^2 - 4ac$; completing the square
Graphing polynomials; repeated roots
- 2.4 Simultaneous equations
- 2.5 Inequalities eg $y - x > 1$; $y > ax^2 + bx + c$

FUNCTIONS

- 2.7 $y = a/x$, $y = 1/x^2$; cubic, quartic; asymptotes
Graphs including modulus
- 2.8 Composite functions
Domain and range; inverse functions
- 2.9 $f(x)$, $g(x)$ then $af(x)$, $f(x) + a$, $f(x + a)$, $f(ax)$

COORDINATE GEOMETRY

- 3.1 Straight lines: $y - y_1 = m(x - x_1)$, $ax + by + c = 0$
 $// m_1 = m_2$; $\perp m_1 m_2 = -1$
- 3.2 Equation of circle; Circle theorems
- 3.3 Parametric eqns: cartesian to parametric
Parametric eqns: circle

TRIGONOMETRY

- 5.1 Graphs of $y = \sin\theta$, $\cos\theta$, $\tan\theta$ for any angle
Radian measure
Circle: arc length $s = r\theta$, sector $A = \frac{1}{2}r^2\theta$
- 5.2 Small angles: $\sin\theta \approx \theta$, $\cos\theta \approx 1 - \frac{1}{2}\theta^2$, $\tan\theta \approx \theta$
- 5.3 Symmetry, period, transformations
- 5.4 $\sec\theta$, $\operatorname{cosec}\theta$, $\cot\theta$
 $\arcsin x$, $\arccos x$, $\arctan x$; $\sin^{-1}x$, $\cos^{-1}x$, $\tan^{-1}x$
- 5.5 $\tan\theta = \sin\theta/\cos\theta$; $\sin^2\theta + \cos^2\theta = 1$
 $\tan^2\theta + 1 = \sec^2\theta$, $\cot^2\theta + 1 = \operatorname{cosec}^2\theta$
Double angles: $\sin 2\theta$, $\cos 2\theta$, $\tan 2\theta$
- 5.6 Trig identities: $\sin(\theta \pm \phi)$, $\cos(\theta \pm \phi)$, $\tan(\theta \pm \phi)$
 $a\cos\theta \pm b\sin\theta = r\sin(\theta \pm \alpha)$ and $r\cos(\theta \pm \alpha)$
- 5.7 Solving trig equations, eg $\sin\theta = 0.5$ [0° , 360°]

EXPONENTIALS AND LOGARITHMS

- 6.1 $y = a^x$; $y = e^x$
 - 6.2 Gradient of $y = e^{(kx)}$ is ke^{kx}
 - 6.3 $x = a^y \Leftrightarrow y = \log_a x$
 - 6.6 Reduction to linear form
 - 6.7 Exponential growth and decay
-

DIFFERENTIATION

- 7.1 Gradient at a point: gradient of tangent
The second derivative
- 7.2 Differentiating $y = kx^n$, $\sin kx$, $\ln x$
- 7.3 Equation of tangent and normal
max and min; point of inflection
- 7.4 Differentiate: Product rule; Quotient rule
- 7.5 Parametric and implicit differentiation

INTEGRATION

- 8.1 Integrate: fundamental theorem of calculus
- 8.2 Integrate: $y = kx^n$; e^{kx} , $1/x$, $\sin kx$
- 8.3 Integrate: constant; indefinite and definite
Area under a curve, and between two curves
- 8.4 Integrate: limit of a sum
- 8.7 1st order differential eqns: separating vars.
- 8.8 1st order differential eqns: links to kinematics

NUMERICAL METHODS

- 9.1 Bisection iteration
- 9.2 $x = g(x)$: $x^3 - x - 4 = 0 \rightarrow x = (x + 4)^{1/3}$
- 9.3 Newton-Raphson method; failures
- 9.4 Integration: trapezium rule; rectangles

VECTORS

- 10.1 2D and 3D: modulus, unit vector, parallel
 - 10.2 Magnitude, direction
 - 10.3 Add, subtract, multiply by a scalar
 - 10.4 Position vectors; distance between two pts
 - 10.5 Problems solved using vectors
-

Paper 3: STATISTICS and MECHANICS

SAMPLING

- 1.1 Population and sample; Sampling techniques

DATA PRESENTATION

- 2.1 Single variable data:
Discrete, continuous, ranked, grouped;
bar chart, dot plot, stem-and-leaf
box-and-whisker, frequency chart
Histogram: frequency density
Cumulative frequency diagram
 - 2.2 Bivariate data:
Scatter diagram; line of best fit
Extrapolation: outliers; correlation
 - 2.3 Central tendency: standard deviation
Discrete, continuous; mean, mode, median
 - 2.4 Outliers: $\text{mean} \pm 2SD$; $1.5 \times IQR$
-

=====

PROBABILITY DISTRIBUTIONS

- 4.1 Binomial: calculate probabilities; mean = np
Discrete uniform distribution
- 4.2 Normal Distribution: continuity correction
Normal: binomial approximation
Normal: area -> probability
Normal: $z = (x - \mu)/\sigma$
Normal: mean $\pm \sigma \Rightarrow$ points of inflexion

STATISTICAL HYPOTHESIS TESTING

- 5.1 Null/alternative, 1, 2-tailed test
 - 5.2 Critical and acceptance regions
 - 5.3 Samples, n, from $X \rightarrow N(\mu, \sigma^2) \rightarrow N(\mu, \sigma^2/n)$
Test using Normal: Critical regions
- =====

MECHANICS: KINEMATICS IN 1 DIMENSION

- 7.1 Displacement, velocity, acceleration, time;
significance of gradient and area
 - 7.3 Constant Acceleration formulae:
 $s = ut + \frac{1}{2}at^2$, $v = u + at$, $v^2 - u^2 = 2as$
 - 7.4 Use of calculus and vectors
 - 7.5 Projectiles: Motion under gravity
Position, velocity, range, max height
Initial velocity; Angle of projection
Trajectory of a projectile
Range on a uniform slope
- =====

Pre-release material: [LARGE DATA SET](#)

=====

=====

Edexcel Further Mathematics

TOPICS FOR AUTOGRAPH

References to

[Pearson-Edexcel A level Mathematics](#)

PAPER 1 and 2: PURE MATHEMATICS

=====

COMPLEX NUMBERS

- 2.1 Solving any quadratic; conjugate pairs;
solving cubic/quartic equations
- 2.2 Real, imaginary, modulus, argument
Add, subtract, multiply, divide; Zero
- 2.3 Complex conjugate
- 2.4 Argand diagram
- 2.5 Modulus-argument form: $z = r(\cos\theta + i\sin\theta)$
- 2.6 $z_1 z_2 = r_1 r_2 (\cos(\theta_1 + \theta_2) + i\sin(\theta_1 + \theta_2))$
 $z_1 / z_2 = r_1 / r_2 (\cos(\theta_1 - \theta_2) + i\sin(\theta_1 - \theta_2))$
- 2.7 Sets of complex numbers as loci
Circles of the form $|z - a| = r$
Half lines of the form $\arg(z - a) = \theta$
Lines of the form $|z - a| = |z - b|$
- 2.8 De Moivre's theorem: $z = e^{i\theta} = \cos\theta + i\sin\theta$
- 2.9 $\cos\theta = (e^{i\theta} + e^{-i\theta})/2$
- 2.10 nth roots: sum are zero

MATRICES AND TRANSFORMATIONS

- 3.3 2-D: transformations using matrices
reflect, rotate, enlarge, stretch, shear
3-D: transformations using matrices
reflection in $x=0$, $y=0$, $z=0$
rotation 90° about x, y or z axis
- 3.4 Invariant points and lines
- 3.5 Determinant of 2×2 and 3×3 ; singular
- 3.7 3D: Solve three simultaneous equations

FURTHER VECTORS

- 6.1 Vector equation of a straight line
 - 6.2 Vector equation of a plane
 - 6.3 Dot product; angle between 2 vectors
 $\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}| |\mathbf{b}| \cos\theta = a_1 b_1 + a_2 b_2 + a_3 b_3$
Vector equation of a plane: $\mathbf{r} \cdot \mathbf{n} = k$
Cartesian form of plane: $n_1 x + n_2 y + n_3 z + d = 0$
Angle between a line and a plane
 - 6.5 Intersection line-plane
Shortest distance between 2 lines
Shortest distance between a pt and a plane
- =====

=====

FURTHER FUNCTIONS

- 4.5 Maclaurin series
- 4.6 ... for e^x , $\ln(1+x)$, $\sin x$, $\cos x$, $(1+x)^n$

FURTHER CALCULUS

- 5.1 Volume of revolution about x- or y-axis
- 5.2 Improper integrals
- 5.3 Mean value of a fn: $1/(b-a)\int f(x)dx$, limits a-b
- 5.5 Differentiate inverse trig functions

POLAR COORDINATES

- 7.1 Polar coordinates
- 7.2 $r = a(1+\cos\theta)$, $r = a\cos 2\theta$ [$r < 0$ broken line]
- 7.3 Area enclosed by a polar curve $A = \frac{1}{2}\int r^2 d\theta$

HYPERBOLIC FUNCTIONS

- 8.1 $\sinh x$, $\cosh x$, $\tanh x$; $\cosh^2 x - \sinh^2 x = 1$
- 8.2 Differentiate and integrate hyperbolics
- 8.3 Inverse hyperbolic functions; log forms
- 8.4 Log forms
- 8.5 Integration

CORE PURE: DIFFERENTIAL EQUATIONS

- 9.1 1st order: Integrating factor: $y' + P(x)y = Q(x)$
- 9.2 General solution and particular integral
- 9.4 2nd order: $y'' + ay' + by = 0$ auxiliary equation
Interpretation of the discriminant
- 9.5 $y'' + ay' + by = f(x)$
- 9.7 SHM $x'' + cx = 0$, $x'' = -\omega^2(x+k) \rightarrow x = A\cos(\omega t - \phi)$
- 9.8 Amplitude, T period = $(2\pi)/\omega$, $v^2 = \omega^2(A^2 - x^2)$
Damped SHM; Critical damping
Roots of auxiliary equation
- 9.9 Coupled 1st order linear, eg predator-prey

=====

PAPER 3A: FURTHER PURE MATHEMATICS 1**FURTHER TRIGONOMETRY**

- 1.1 t-formulae

FURTHER CALCULUS

- 2.1 Taylor Series
- 4.1 Parametric equations: parabola, hyperbola
- 4.2 Focus-directrix of parabola
- 4.3 Tangents and normal
- 4.4 Loci

FURTHER VECTORS

- 5.1 Vector Product
- 5.2 Scalar triple product

FURTHER NUMERICAL METHODS

- 6.1 1st Order D.E by Runge-Kutta
- 6.2 Simpson's Rule

PAPER 4A: FURTHER PURE MATHEMATICS 2

- 2.2 Arc Length and area of surface of revolution
- 3.1 Eigenvalues and eigenvectors (2D and 3D)
- 4.1 Further loci in Argand Diagram
 $|z-a| = k|z-b|$
 $\arg(z-a)/(z-b) = \beta$
 $\alpha \leq \arg(z-z_1) \leq \beta$
 $p \leq \operatorname{Re}(z) \leq q$

PAPER 4B: FURTHER STATISTICS

- 2.1 Poisson Distribution: $\mu = \lambda$, $\sigma^2 = \lambda$
- 2.2 Binomial distribution: $\mu = np$, $\sigma^2 = npq$
- 2.3 Poisson as approx. to binomial
- 3.2 Geometric distribution: $\mu = 1/p$, $\sigma^2 = (1-p)/p^2$
- 5.1 Central Limit Theorem

PAPER 4E: Further Statistics 2

- 1.1 Least Squares regression; residuals
- 3.1 Product Moment CC
- 3.2 Spearman's Rank CC

=====

Douglas Butler

January 2021

=====