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**A LEVEL: Edexcel Mathematics**  
**TOPICS FOR AUTOGRAPH [Sept 2021]**  
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References to [Pearson-Edexcel A level Mathematics](#)  
Red items not yet implemented in Web-Autograph

**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; 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  $\sin\theta = 0.5$  [ $0^\circ$ ,  $360^\circ$ ]

**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
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**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
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**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:  $\text{mean} \pm 2\text{SD}$ ;  $1.5 \times \text{IQR}$
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## 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
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## MECHANICS: KINEMATICS IN 1 DIMENSION

- 7.1 Displacement, velocity, acceleration, time;  
significance of gradient and area  
Changing axes variables, eg to x, t
  - 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
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Pre-release material: [LARGE DATA SET](#)

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## Edexcel Further Mathematics

### TOPICS FOR AUTOGRAPH

References to

[Pearson-Edexcel A level Mathematics](#)

Red items not yet implemented in Web-Autograph

## PAPER 1 and 2: PURE MATHEMATICS

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### 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  $90^\circ$  about x, y or z axis
- 3.4 Invariant points and lines
- 3.5 Determinant of  $2 \times 2$  and  $3 \times 3$ ; 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  
 $a \cdot b = |a| |b| \cos\theta = a_1 b_1 + a_2 b_2 + a_3 b_3$   
Vector equation of a plane:  $r \cdot n = k$   
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
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## 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 and polar axes

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

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## 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 (3D)

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

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April 2023