APPENDIX: FORMULAE AND RULES

POINTS AND LINES

MIDPOINT	$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$
DISTANCE	$\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$
SLOPE	$\frac{y_2 - y_1}{x_2 - x_1}$
LINE THROUGH (x_1, y_1) WITH SLOPE *m*	$y - y_1 = m(x - x_1)$
PARALLEL LINES	$m_1 = m_2$
PERPENDICULAR LINES	$m_1 m_2 = -1$

DIFFERENTIATION

SUM AND DIFFERENCE	$\frac{\mathrm{d}(u \pm v)}{\mathrm{d}x} = \frac{\mathrm{d}u}{\mathrm{d}x} \pm \frac{\mathrm{d}v}{\mathrm{d}x}$
CONSTANT FACTOR	$\frac{\mathrm{d}(ku)}{\mathrm{d}x} = k\frac{\mathrm{d}u}{\mathrm{d}x}$
PRODUCT RULE	$\frac{\mathrm{d}(uv)}{\mathrm{d}x} = u \cdot \frac{\mathrm{d}v}{\mathrm{d}x} + v \cdot \frac{\mathrm{d}u}{\mathrm{d}x}$
QUOTIENT RULE	$\frac{\mathrm{d}(u/v)}{\mathrm{d}x} = \frac{v\frac{\mathrm{d}u}{\mathrm{d}x} - u\frac{\mathrm{d}v}{\mathrm{d}x}}{v^2}$
CHAIN RULE	$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{\mathrm{d}y}{\mathrm{d}u} \cdot \frac{\mathrm{d}u}{\mathrm{d}x}$

INVERSE FUNCTIONS	$\frac{dx}{dy} \cdot \frac{dy}{dx} = 1$

FUNDAMENTAL THEOREM OF CALCULUS	$\frac{d\int f(x)\,dx}{dx} = f(x)$	$e^x = \sum_{0}^{\infty} \frac{x^n}{n!}$

STATIONARY POINTS AND OPTIMISATION

Optimising $y = f(x)$: Put $\frac{dy}{dx} = 0$.			Optimising $z = f(x, y)$: Put $\frac{\partial z}{\partial x} = \frac{\partial z}{\partial y} = 0$.		
FIRST DERIVATIVE TEST			**SECOND DERIVATIVE TEST**		
Local MIN	Local MAX	Inflection	$y'' < 0$ Local MAX	$y'' = 0$ TEST FAILS	$y'' > 0$ Local MIN

INTEGRATION

$\int[u \pm v]\,dx = \int u\,dx) \pm \int v\,dx$		$\int ku\,dx = k\int u\,dx$
IF $\int f(x)\,dx = F(x)$	$\int_a^b f(x)\,dx = [F(x)]_a^b = F(b) - F(a)$	$\int f(ax + b)\,dx = \frac{1}{a}F(ax + b)$.
AREA BETWEEN CURVES from *a* to *b*	$\int_a^b (\text{top } y - \text{bottom } y)dx$	

SPECIAL FUNCTIONS

y	$\frac{dy}{dx}$	$\int y\,dx$ (include + c)
x^n	nx^{n-1}	$\frac{1}{n+1}x^{n+1}$ if $n \neq -1$
$\frac{1}{x}$	$-\frac{1}{x^2}$	$\log x$
e^x	e^x	e^x
$\log x$	$\frac{1}{x}$	$x \log x - x$
$\sin x$	$\cos x$	$-\cos x$
$\cos x$	$-\sin x$	$\sin x$
$\tan x$	$\sec^2 x$	$\log(\sec x)$

NUMERICAL METHODS

NEWTON'S METHOD to solve $y = f(x) = 0$	$x_1 = x_0 - \frac{y_0}{y_0'}$
$\int_a^b y\,dx$ using n strips of width h	
TRAPEZIUM RULE	$\frac{h}{2}$ [First + Last + 2(Sum of others)].
CUBIC FIT RULE	TRAPEZIUM RULE $- \frac{h^2}{12}[y']_a^b$
SIMPSON'S RULE even number of strips	$\frac{h}{3}$ [first + last + 2(sum of other evens) + 4(sum of odds)]

TANGENTS

Tangent to $y = f(x)$ at $x = a$	$y - f(a) = f'(a)(x - a$
Point of contact of tangent(s) to $y = f(x)$ through (a, b)	Solve $b - f(t) = f'(t)(a - t)$ Point of contact is $(t, f(t))$

LINEAR DIFFERENTIAL EQUATIONS

$\frac{dy}{dx} = ky$	$y = Ae^{kx}$
$a\frac{d^2y}{dx^2} + b\frac{dy}{dx} + cy = 0$ where λ, μ are two real zeros of $aX^2 + bX + c$.	$y = Ae^{\lambda x} + Be^{\mu x}$

LAGRANGE MULTIPLIERS

PARTIAL DERIVATIVES	$\frac{\partial z}{\partial x}$ = derivative keeping all other variables fixed
MAX and MIN of $F(x, y)$ subject to the constraint $\varphi(x, y) = 0$.	Solve $\frac{\partial z}{\partial x} = \frac{\partial z}{\partial y} = \varphi(x, y) = 0$.

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LIST OF TITLES

GENERAL
- The Mathematics At The Edge Of The Rational Universe

ELEMENTARY
- Basic Mathematics
- Concepts of Algebra
- Concepts of Calculus

1st YEAR UNI
- Techniques of Algebra
- Techniques of Calculus
- Matrices

2nd YEAR UNI
- Linear Algebra
- Languages & Machines
- Discrete Mathematics

3rd YEAR UNI
- Group Theory vol 1
- Group Theory vol 2
- Galois Theory
- Geometry vol 1
- Geometry vol 2
- Topology
- Set Theory
- Number Theory
- Graph Theory
- Complex Variables

POSTGRADUATE
- Ring Theory
- Representation Theory
- Quadratic Forms
- Group Tables vol 1
- Group Tables vol 2