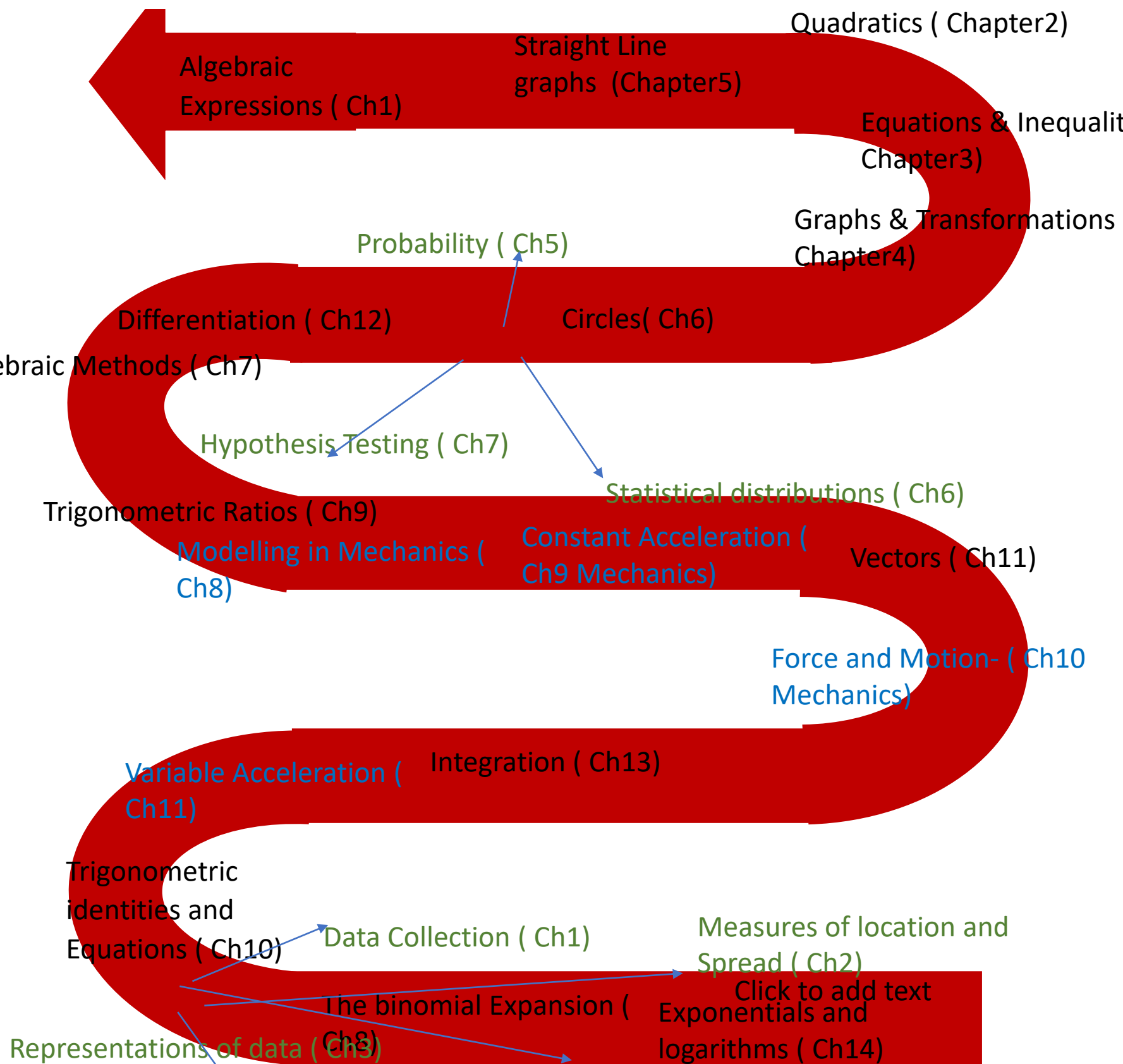


# AS-Level Maths



## Key Stage 4

algebraic manipulation, solving linear and quadratic equations, applying laws of indices, Equation of a line  $y = mx + c$ , solving a pair of simultaneous equations.

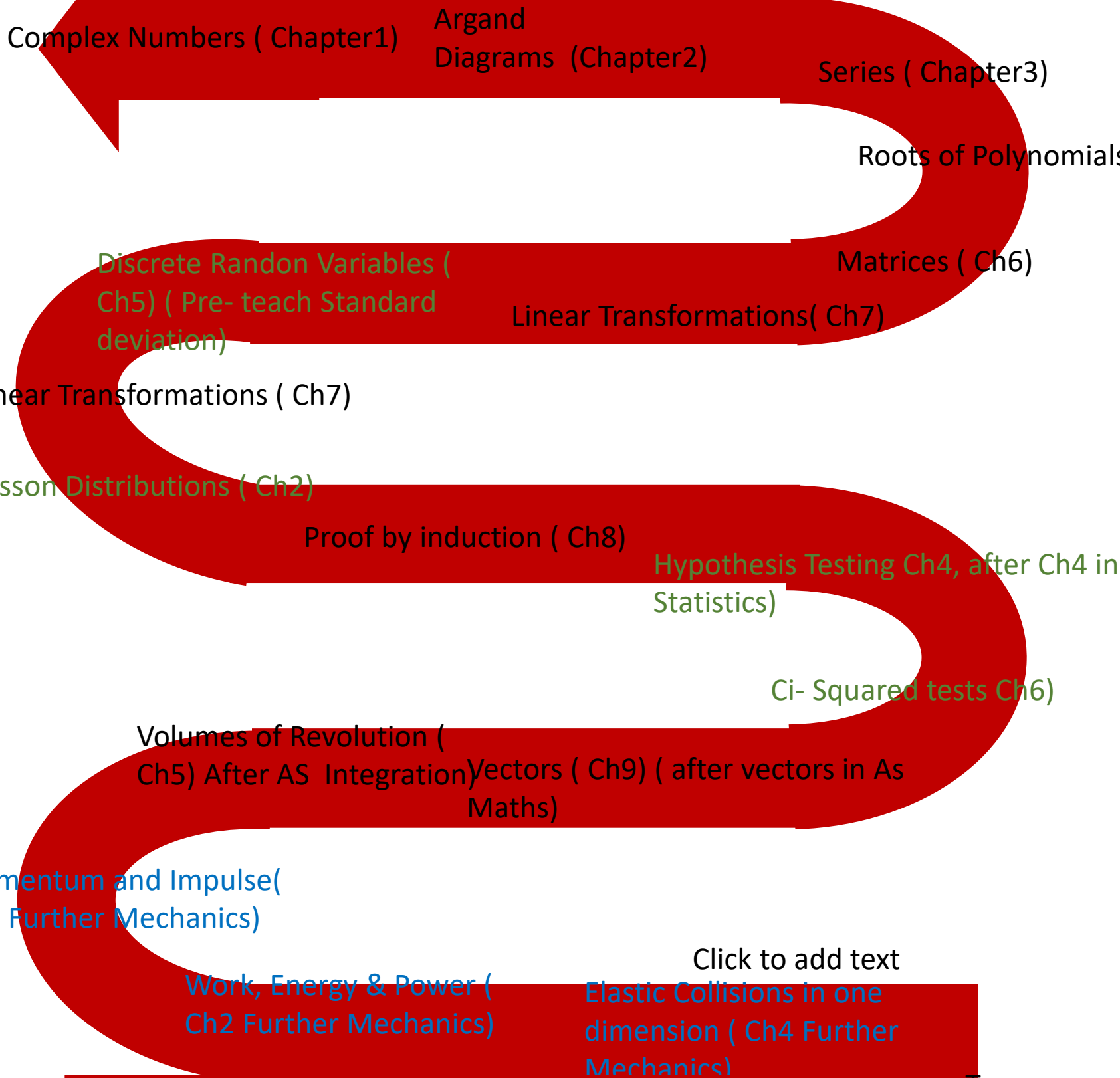
Simplifying a surd, operations with surds, rationalising the denominator of a surd, Solving problems involving parallel and perpendicular lines

applying laws of indices with fractional and negative powers, operations with algebraic fractions, application of Pythagoras Theorem and Trigonometry



Respect  
Well-being  
Balance  
Aspiration

# AS-Level Further Maths



## Key Stage 4

algebraic manipulation, solving linear and quadratic equations, applying laws of indices ,Equation of a line  $y = mx + c$ , solving a pair of simultaneous equations.

Simplifying a surd, operations with surds, rationalising the denominator of a surd, Solving problems involving parallel and perpendicular line

applying laws of indices with fractional and negative powers, operations with algebraic fractions, application of Pythagoras Theorem and Trigonometry

# A-Level Pure Maths

## Trigonometry (part 1)

Radians (definition and exact values), Small angles, Secant, cosecant and cotangent (definitions, identities and graphs) Inverse trigonometrical functions

## Differentiation

Differentiating  $\sin x$  and  $\cos x$  principles  
Differentiating exponentials, logarithms, Differentiating products and implicit functions, derivatives (rates of change and inflections) Rates of change problems (including growth and kinematics)

## Algebraic and partial fractions

Simplifying algebraic fractions

Partial fractions

## Integration

Integrating  $x^n$  (including when  $n = -1$ ), exponentials and trigonometric functions. Using the reverse of differentiation, and using trigonometric identities to manipulate integrals. Integration by substitution, Integration by parts, Use of partial fractions, Areas under graphs or between two curves, including understanding the area is the limit of a sum (using sigma notation), The trapezium rule, Differential equations (including knowledge of the family of solution curves)

### Proof:

Examples including proof by deduction\* and proof by contradiction

## Functions and modelling

Modulus function, Composite and inverse functions, Transformations, Modelling functions\*

## Trigonometry (part 2)

Arcs and sectors, Compound and double (and half) angle formulae,  $R \cos(x \pm \alpha)$  or  $R \sin(x \pm \alpha)$ , Proving trigonometric identities,

## The binomial theorem

Expanding  $(a + bx)^n$  for rational  $n$ ; knowledge of range of validity, Expansion of functions by first using partial fractions.

## Series and sequences

Arithmetic and geometric progressions (of 'sum formulae'), Sigma notation and iterations

Solving problems in context (e.g. mechanics)

## Parametric equations

Definition and converting between parametric and Cartesian forms (curve sketching and modelling), Differentiating parametric, Integrating functions defined parametrically  
Areas under curves expressed parametrically

## Numerical methods\*

Location of roots, Solving by iterative methods (knowledge of 'staircase and cobweb' diagrams), Newton-Raphson method, Problem solving

## Vectors (3D):

Use of vectors in three dimensions; kolumn vectors and i vectors

Key Stage 5 AS

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# A-Level Applied Maths

## The Normal distribution

Understand and use the Normal distribution

Use the Normal distribution as an approximation to the binomial distribution  
Selecting the appropriate distribution

Statistical hypothesis testing for the mean of the Normal distribution

## Probability

Using set notation for probability  
Conditional probability

Questioning assumptions in probability

## Regression and correlation

Change of variable

Correlation coefficients  
Statistical hypothesis testing for zero correlation

**Forces at any angle (part 1):** Resolving forces

**Further kinematics (part 1):** Constant acceleration (equations of motion in 2D; the  $\hat{i}, \hat{j}$  system)

**Applications of kinematics:** Projectiles

**Forces at any angle (part 2):** Friction forces (including coefficient of friction  $\mu$ )

## Applications of forces (part 1)

Equilibrium and statics of a particle

Dynamics of a particle

**Further kinematics (part 2):** Variable acceleration (use of calculus and finding vectors  $\mathbf{r}$ , and  $\mathbf{r}''$  at a given time)

**Moments:** Forces' turning effect

**Applications of forces (part 2):** Equilibrium and statics of a particle (including ladder problems)

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# A-level Further Maths-

## Pure

### Complex numbers

Know and use  $z = re^{i\theta} = r(\cos \theta + i \sin \theta)$

De Moivre's theorem

The  $n$ th roots of  $z = re^{i\theta}$  and complex roots of unity

### Hyperbolic functions

$\sinh x$ ,  $\cosh x$ ,  $\tanh x$  and their inverses

Logarithmic forms of the inverse hyperbolic functions and integrate functions of the form

$$(x^2 + a^2)^{-1/2}$$

$$\text{and } (x^2 - a^2)^{-1/2}$$

### Further algebra and functions (series)

Method of differences

Maclaurin series

### Polar coordinates

Convert between Cartesian and polar and sketch  $r(\theta)$

Area enclosed by a polar curve

### Further calculus

Improper integrals

Mean value of a function

Integrate using partial fractions

Differentiate inverse trigonometric functions and integrate using trigonometric substitutions

Further volumes of revolutions

### Differential equations

Integrating factors to solve first order differential equations

Second order differential equations of the form  $y'' + ay' + by = f(x)$

Modelling

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# A-Level Further

## Statistics

**Geometric and negative binomial distributions** : The geometric distribution, its mean and variance, The negative binomial distribution, its mean and variance

**Hypothesis testing :**  
Hypothesis test for the parameter  $p$  of a geometric distribution

### The Central Limit

**Theorem :** Applications of the Central Limit Theorem

### Chi squared tests (part 2) :

Chi squared tests

### Quality of tests :

Type I and Type II errors  
The size and power of a test. The power function

### Probability generating functions

: Definitions, derivations, applications and use to find the mean and variance, Use of the probability generating function for the negative binomial, geometric, binomial and Poisson distributions Probability generating function of the sum of independent random variables

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# A-Level Further Mechanics

## Momentum and impulse (part 2)

Momentum as a vector ( $\mathbf{i}$ ,  $\mathbf{j}$  problems)  
Impulse-momentum principle in vector form

**Elastic strings and springs and elastic energy** : Hooke's law and definition of modulus of elasticity. Derivation of elastic potential energy formula. Problem solving: equilibrium and using the work-energy principle

**Elastic collisions in two dimensions** : Oblique impact of a smooth sphere with a fixed surface Successive oblique impacts of a sphere with smooth plane surfaces, Oblique impact of two smooth spheres of equal radius

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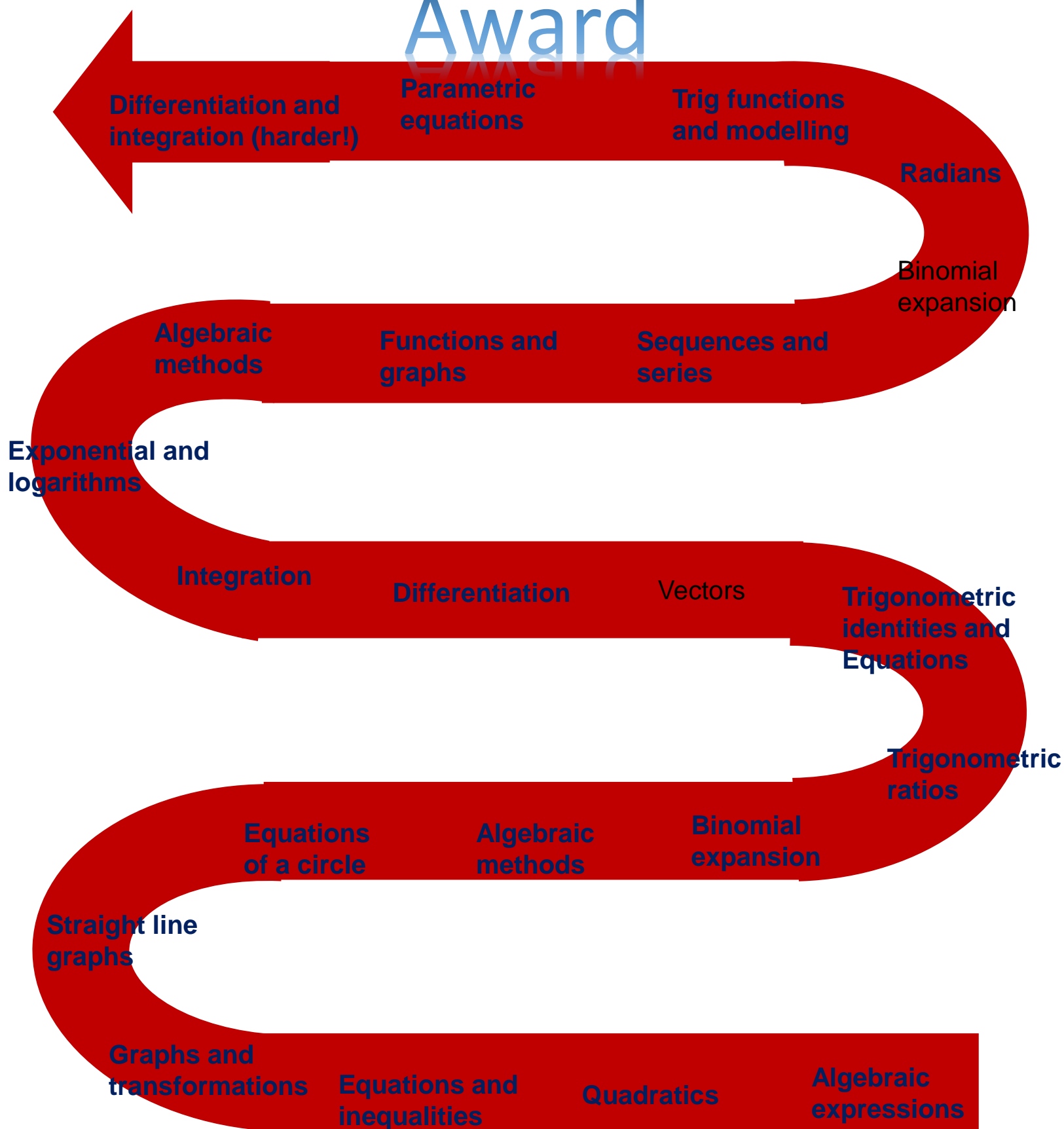
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# Advanced Extension Award



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