

## The Scope of Ancient Mathematics<sup>1</sup>

Ancient mathematics was mostly applied arithmetic. But there are other facets.

- Number — ordinal vs cardinal
- Base — binary, ternary, decimal, sexagesimal, etc
- Arithmetic — addition, multiplication, etc
- Geometry — areas and volumes
- Number Theory — Pythagorean triples, primes, etc
- Algebra — solution of equations

**Number and Base.** The very way numbers are represented has a profound impact on the mathematics of a civilization.

- Number and types of symbols
- Positional and non-positional representation
- Positive numbers vs negative numbers
- Fractions
- Rational numbers
- Incommensurable numbers

**Arithmetic.** Arithmetic had simple and pragmatic origins. Many different systems were developed. Our own system evolved more than 2,000 years before it took its present form.

- Basic operations — binary based, table based, grouping
- Algorithms for multiplication and division
- The nature of fractions, decimals(?)
- Taking square roots

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**Geometry.** Born of practical needs to compute areas and volumes and eventually make angular measurements, geometry eventually became the theoretical model for all sciences to emulate.

- Ideas of similarity of figures
- Formulas for areas and volumes (some incorrect)
  - quadrilaterals and circles
  - parallelepipeds and pyramids
- Classification of curves and shapes
- Regular solids
- Full axiomatic development
- Method of exhaustion (the first limit)

**Number Theory.** As with most ancient mathematics, number theory had its origins with construction of shapes, but it rapidly assumed a life of its own.

- Figurate numbers
- Pythagorean triples
- Characterization of numbers into primes, amicable, abundant, deficient
- Theorems about numbers, tables of results
- rational numbers – incommensurable numbers, (The square root of two took many years to assimilate though its geometric origins are the most basic.)

**Algebra.** The first problems of algebra were practical, dividing inheritances, computing logistic needs, allocation of resources, determining volumes and areas, etc.

- Solution of linear equations
- Solution of linear systems
- Solution of quadratics — algebraically vs geometrically
- Iterative methods
- Positive vs negative solutions

**Other issues of ancient mathematics:**

- Level of rigor — from examples to formulas to theorems
- Dynamically vs statically defined curves
- Rhetorical vs symbolic expressions
- Applied vs pure mathematics
- Angular measurements — astronomy
- Quadratures of shapes — the need for a limiting-like process.

**Methods of computation/problem solving:**

- By example
- Method of false position
- Geometric construction
- Rhyme