Chapter 2. Babylonian and Egyptian Mathematics

Study Guide

The following is a brief list of topics covered in Chapter 2 of Howard Eves' *Introduction to the History of Mathematics*, 6th Edition (Saunders College Publishing, 1990). This list is not meant to be comprehensive, but only gives a list of several important topics. You should also carefully study the proofs, constructions, and examples given in class, and the homework problems.

Section 2.1. The Ancient Orient.
Locations of the first cities and associated rivers, tendencies toward abstract, recipes versus proof, preservations of Babylonian and Egyptian records, lack of preservation of records from India and China.

Section 2.2. Babylonia: Sources.
Clay tablets from the Mesopotamian region, collections of clay tablets, the Behistun Inscription and the deciphering of cuneiform writing, Henry Rawlinson, Old Babylonian Empire, Kassite dynasty, Assyrian period, Neo-Babylonian Empire (i.e., Second Babylonian Empire), Otto Neugebauer biography, astronomical observations and their relevance to the development of mathematical knowledge.

Section 2.3. Babylonia: Commercial and Agrarian Mathematics.
Babylonians used a base 60 positional system, Sumerians created legal and domestic contracts on clay tablets, mathematical tables on clay tablets (multiplication tables, tables of reciprocals, tables of squares and cubes), sexagesimally regular numbers, necessary and sufficient condition for a number to be sexigesimally regular (Problems Study 2.1).

Section 2.4. Babylonia: Geometry.
The Babylonians knew area and volumes of some objects, Old Babylonian math texts, Seleucid Babylonian math texts, table texts, problem texts, school texts, National Museum of Iraq tablet number IM 067118 (or Db_2 146) and a "proof" of the Pythagorean Theorem (Notes 2.4.B), Babylonian approximation of π as $3\frac{1}{8}$ based on circles and inscribed hexagons (Note 2.4.C), frustum of a pyramid, piling bricks and systems of equations (Note 2.4.D).

Section 2.5. Babylonia: Algebra.

Clay tablet YBC 6967 and finding the dimensions of a rectangle (Note 2.5.A), Louvre Museum tablet AO 6484 and summation formulas including summation of a geometric progression (Note 2.5.B), Berlin Museum tablet VAT 8492 and "normal form" cubic polynomials (Note 2.5.C), Strasbourg tablet number 363 and the introduction of a quadratic equation and its solution with the quadratic formula (Note 2.5.D), tablet YBC 7289 an the approximation of $\sqrt{2}$ as 1.414212963 (Note 2.5.E), Babylonian strength in mathematics and their likely knowledge of the Pythagorean Theorem and the quadratic formula.

Section 2.6. Babylonia: Plimpton 322.

History of Plimpton 322 (its discovery and description), the physical appearance of Plimpton 322 and breakage, numerical values on the tablet (and errors), Pythagorean triples and primitive Pythagorean triples, representation of primitive Pythagorean triples (Theorem 16.1), sexagesimally regular numbers and their classification, Plimpton 322 represents evenly spaced values of the secant of an angle for angles between 31° and 45°, extensions of the Plimpton 322 table to include other angles.

Section 2.7. Egypt: Sources and Dates.

Caravan routes and the impact on Babylon and Egypt, Old Babylon was more mathematically advanced than Egypt, Babylon and Egypt were both theocracies with slave populations, preservation of Egyptian records due to the dry climate and writing on stone tombs and temples, the Narmer macehead and numerical engravings (Note 2.7.A), the Giza pyramid complex (the Great Pyramid of Khufu [or Cheops], the Pyramid of Khafre, and the Pyramid of Menkure), dimensions of the pyramids, the Moscow Mathematical Papyrus (25 problems according to V. V. Struve, pefsu problems, Baku problems, and geometry problems; Note 2.7.C), the Rhind Mathematical Papyrus (its history and age, fragments, hieratic script, Ahmes the scribe, references for translations), content of the Rhind Papyrus (two tables, 40 problems on arithmetic and elementary algebra, 20 problems on geometry, approximation of π as $256.81 \approx 3.1605$, 14 problems on miscellaneous topics, and 3 "Numbers"), the Rollin Papyrus (its origins and applications of math to bread making), the Rosetta Stone and its history (King Ptolemy V Epiphanes, Napoleon, Bouchard, the British defeat of the French in Egypt in 1801), three types of writing on the Rosetta Stone (Egyptian hieroglyphic, Egyptian Demotic, and ancient Greek), Champollion's pivotal role in translation of the Egyptian scripts.

Section 2.8. Egypt: Arithmetic and Algebra.

The use of doubling (and powers of 2) in Egyptian multiplication and division (Note 2.8.A), Problem 6 form the Moscow Mathematical Papyrus (the lengths of the sides of a rectangle, the taking of a square root, and the square root sign; Note 2.8.B), unit fractions and their hieroglyphs (for 1/3, 1/4, 1/2, and 2/3), the *pefsu* problem in Problem 8 of the Moscow Papyrus (the formula for *pefsu* and its application), Part I (arithmetic and elementary algebra) of the Rhind Mathematical Papyrus (tables and their application, Problem 24, Problem 31, Problem 40; Note 2.8.D), the rule of false position, the Khaun Papyri and the Lahun Mathematical Papyri (similarities to the Rhind Papyrus, with tables, arithmetic progressions, and baku problems), the (limited) use of algebraic symbolism by the Egyptians.

Section 2.9. Egypt: Geometry.

Problem 10 of the Moscow Papyrus on the surface area of a hemisphere and the approximation of π as $256/81 \approx 3.16049$ (Note 2.9.A), Problem 14 of the Moscow Payrus on the volume of a frustum of a pyramid (and the implication that it gives a general formula for the volume of a frustum; Note 2.9.B), Problem 41 from the Rhind Papyrus on the volume of a cylinder (unit conversion and the approximation of π as $256/81 \approx 3.16049$ again; Note 2.9.C), Problem 48 from the Rhind Papyrus on the ratio of the area of a circle to its circumscribing square (Note 2.9.D), Problem 56 of the Rhind Papyrus on the *seked* of a pyramid (the relation between the *seked* and the slope of the side of the pyramid, the *seked* as the cotangent of an angle in an associated right triangle, the *seked* carries a unit of length; Note 2.9.E).

Section 2.10. Egypt: A Curious Problem in the Rhind Papyrus.

Problem 79 of the Rhind Papyrus in Part III "Miscellany," a geometrical progression with first term 7 and multiplier 7, summing geometric sequences, Moritz Cantor's interpretation of the problem as a word problem, Leonardo of Pisa's ("Fibonacci") "Seven Old Men Go to Rome" story in *Liber abbaci*, the English nursery rhyme "As I was going to St. Ives."

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