

Chapter 6. Greek Mathematics

After Euclid

6.1. Historical Setting

Note. We left off in [Section 5.1. Alexandria](#) with the founding of the Mouseion of Alexandria and its associated Library of Alexandria.

Note 6.1.A. A century after its founding, Alexandria had become the largest city in the world. Rome would overtake it in population, but Alexandria would remain the second largest city for centuries. It was populated in part by Greeks from many different cities. Under Ptolemy I, the Heptastadion was built to connect the island of Pharos to the mainland (see the map below).



Alexandria 300 BCE to 100 BCE, from the [Wikipedia webpage on the Tomb of Alexander the Great](#) (accessed 8/22/2023)

This was followed by the construction of the Lighthouse of Alexandria and the Serapeum of Alexandria (a temple dedicated to Serapis, who was made the protector of Alexandria). The three ethnic populations of Alexandria were Greek, Jewish, and Egyptian. Ethnic divisions, combined with an attitude of Greek superiority, lead to turbulence in the Alexandrian population starting during the reign of Ptolemy IV Philopater (who reigned from 221 BCE to 204 BCE). The reign of Ptolemy VIII Physcon (from 144 BCE to 116 BCE) was marked by purges and civil warfare. Even with these internal struggles, the reign of the Ptolemies (from 305 BCE to 30 BCE) was largely marked by an absence of external strife. The source for this note is the [Wikipedia webpage on the History of Alexandria](#) (accessed 8/24/2023).

Note 6.1.B. In 212 BCE Syracuse fell to the expanding Roman Republic. In 146 BCE Carthage and Corinth fell, turning Greece into a province of the Roman Empire. Mesopotamia was conquered in 65 BCE. See Eves, page 164. Roman influence was felt in Alexandria since this expansion started, but it did not come under Roman jurisdiction until 80 BCE. Egypt remained under the Ptolemies until 30 BCE. Marcus Antonius (or “Mark Antony”; January 14, 83 BCE–August 1, 30 BCE) was a Roman politician and general who is a key figure in this story. He was one of Julius Caesar’s (July 12, 100 BCE–March 15, 44 BCE) generals. After Caesar’s assassination, Antony joined with Marcus Aemilius Lepidus (circa 89 BCE–13 or 12 BCE) and Gaius Octavian (later to become Caesar Augustus; September 23, 65 BCE–August 19, 14 CE) forming a three-man dictatorship which has become known as the Second Triumvirate. Antony was in charge of Rome’s eastern provinces, including Egypt (then ruled by Cleopatra VIII, who reigned from

51 BCE to 30 BCE). Relations between Antony and Octavian became strained and to relieve tensions, Antony married Octavian's sister, Octavia. However, Antony had an affair with Cleopatra (they had three children together). In 31 BCE, Octavian had the Roman Senate declare war on Cleopatra and proclaimed Antony a traitor. The Battle of Alexandria was fought from July 1 to July 30, 30 BCE between the forces of Octavian and Mark Antony. It was the last war of the Roman Republic. Octavian was victorious, and Antony and Cleopatra died by suicide. (You might know some of this story from the Shakespearean play "Antony and Cleopatra" or the 1963 20th Century-Fox movie *Cleopatra* (with Elizabeth Taylor and Richard Burton).) This marks the end of the Greek Hellenistic Period. In 27 BCE Octavian was given the title Emperor Augustus, marking the end of the Roman Republic and the beginning of the Roman Empire, of which Alexandria was part. This was the end of the Hellenistic Period. This note is based on the Wikipedia pages on Eves and the Wikipedia pages on [Mark Antony](#) and [the Hellenistic Period](#) (both accessed 8/24/2023).

Note 6.1.C. During the Roman era, Alexandria covered an area of four square miles and had a population that ranged between 500,000 and 600,000. Jewish-Greek ethnic tensions erupted in 38 CE in violence and desecration of synagogues; this event became known as the Alexandrian pogroms. Similar problems occurred in 66 CE. In 115 CE Alexandrian buildings were burned in the Kitos War (a major war in the Jewish-Roman wars of 66 CE to 136 CE), leading to a need to rebuild parts of the city. In 215 CE Roman Emperor Caracalla (or Marcus Aurelius Antoninus; April 4, 188 CE–April 8, 217 CE) visited Alexandria and, enraged by insults from

the inhabitants, he ordered his troops to kill all youths capable of bearing arms. The massacre that followed (apparently including victims beyond what Caracalla ordered) led to over 20,000 people killed.

Note 6.1.D. Constantine (or “Constantine the Great”; February 27 circa 272 CE– May 22 337 CE) was Roman emperor from 306 to 337. He was the first emperor to convert to Christianity around 312 CE, after living most of his life as a pagan (the term “pagan” was first used in the fourth century by early Christians for people of the Roman empire who followed polytheism).



The Colossus of Constantine in the Capitoline Museum in Rome (left; from the [Wikipedia webpage on Constantine the Great](#)), and Constantine on a Roman coin which belongs to my wife (right).

He was deeply involved in the Edict of Milan in 313 which declared tolerance for

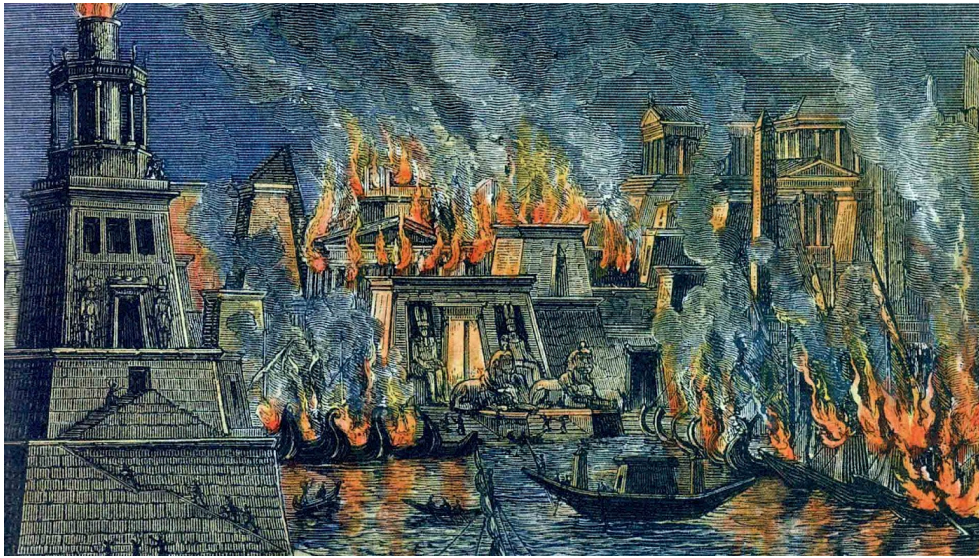
Christianity in the Roman Empire. In 325 CE, Constantine called a council of Christian bishops in the city of Nicaea (today, the town of İznik on Lake İznik in northwestern Turkey). This was the first effort to standardize the Christian church and to establish a procedure for creating statements of beliefs and canons of doctrinal orthodoxy. He built a new imperial residence in the ancient Greek city of Byzantium. He first renamed Byzantium “New Rome” and later named it “Constantinople” after himself (it is modern-day Istanbul, Turkey). It became the capital of the Eastern Roman Empire (sometimes called the Byzantine Empire). The source for this note is the [Wikipedia webpage on Constantine the Great](#) (accessed 8/24/2023).

Note 6.1.E. The last wide-spread persecution of Christians by the Roman Empire was under Diocletian (Roman emperor from 284 CE to 305 CE), called the “Era of Martyrs.” After Emperor Constantine, the Roman Empire became a proponent of the spread of Christianity, instead of an opponent of it. Even though Alexandria was originally known for its pagan learning, during the 4th century CE it became a center for Christian theology and government, and would remain influential as such for the next two centuries. An earthquake centered on the island of Crete on July 21, 365 CE resulted in a tsunami that devastated Alexandria. In the 4th century CE the roles of pagans and Christians reversed, and in the late 4th century the persecution of pagans by Christians intensified. Pagan temples and statues were destroyed throughout the Roman Empire. Pagan rituals were outlawed and made punishable by death. Theodosius I (January 11, 347 CE–January 17, 395 CE; Roman emperor from 379 to 395) ordered the destruction of all pagan temples

in 391 CE. The Serapeum of Alexandria was destroyed (if it was still standing, then the Library of Alexandria was likely destroyed then as well; we'll discuss its demise below in Note 6.1.F). In the 5th century CE, many of the Alexandrian pagan monuments and buildings that had not been destroyed had fallen into ruin, or converted to Christian churches. In 619 CE, Alexandria was taken by Khosrow II, King of Persia. It was retaken by the Byzantine Emperor Heraclius a few years later, but recaptured by Arabs in 641 CE after a 14 month siege during the Muslim conquest of Egypt. In 645 CE, Alexandria changed hands again when a Byzantine fleet recaptured it. For a final time, it was recaptured the following year. This was the end of 975 years of Greek and Roman control of Alexandria, and the beginning of Arab control. The sources for this note are the Wikipedia webpages on [Alexandria](#) and [the History of Alexandria](#) (accessed 8/24/2023).

Note 6.1.F. As we saw in [Section 5.1. Alexandria](#), the Mouseion of Alexandria (along with the Library of Alexandria) was set up by Ptolemy I and II between about 280 BCE and 270 BCE (see Note 5.1.D). Alexandria came to be known as the capital of information and learning, and this is in large part due to “Great Library” of Alexandria. The Ptolemaic kings funded the libraries and encouraged the collecting of texts. An accurate estimation of the size of the collection in the Library is impossible, but estimates range from 40,000 to 400,000 papyrus scrolls at its height. Parchment was used at the time in other places, but in Alexandria the works were recorded on papyrus scrolls. During the reign of Ptolemy III Euergetes (who reigned from 246 BCE to 222 BCE) opened a second library in the Serapeum. A popular modern misconception is that the Great Library was burned one time,

resulting in its destruction. In reality, it declined gradually over the course of several centuries. The problems started with Ptolemy VIII Physcon (circa 184 BCE–June 28, 116 BCE) who, in 145 BCE purged Alexandria of intellectuals, who fled to other cities. During Julius Caesar's Civil War (with Gnaeus Magnus over who should serve as emperor), apparently the Library or part of its collection was accidentally burned, though whatever burned seems to have later been rebuilt.



An image of the burning of the Library of Alexandria by Hermann Göll (1876), with the Lighthouse of Alexandria on the left, from the *Ancient World Magazine website* (accessed 8/25/2023). Maybe the Great Library was burned, or maybe it wasn't!

Emperor Claudius (who reigned from 41 CE to 54 CE is recorded as having built an addition to the Library, but overall, the Library further declined during the Roman Period (30 BCE–641 CE) as did Alexandria itself. The Mouseion still existed after the Roman take-over, but standards had been lowered (or abandoned) and memberships were given out as political favors. While the reputation of Alexandrian scholarship declined, other libraries around the Mediterranean grew in status.

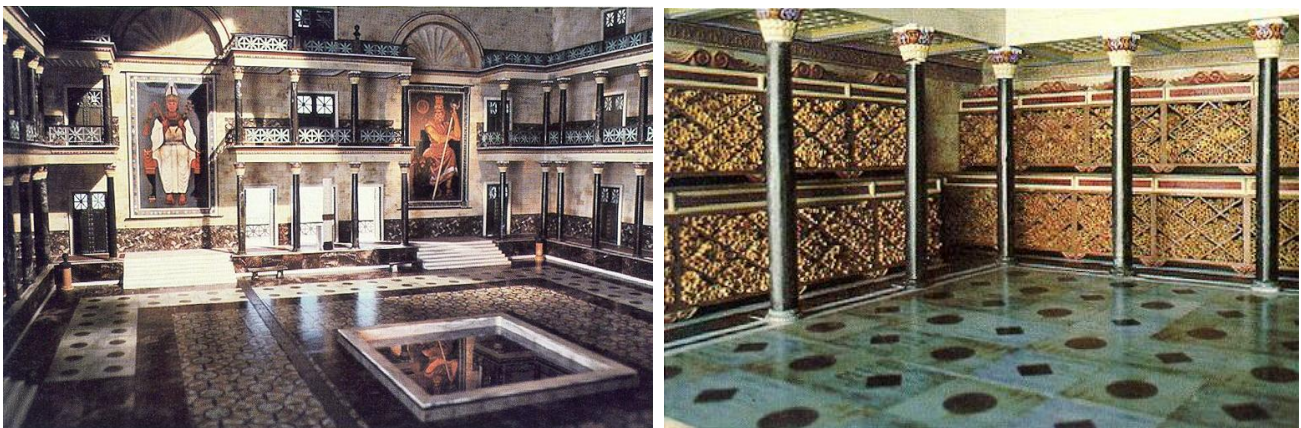
Other libraries were also appeared in Alexandria, possibly stocked by some of the scrolls from the Great Library. Mention of the Great Library and the Mouseion in which it was housed disappear after the middle of the third century CE. Between 270 CE and 275 CE Alexandria was invaded by Palmyra (an ancient city in what is today Syria) and whatever remained of the Library was probably destroyed then. The Serapaum (sometimes called the “daughter library” of Alexandria) was demolished in 391 CE, as mentioned in Note 6.1.E above. The source for this note is the [Wikipedia webpage on the Library of Alexandria](#) (accessed 8/25/2023). In my on-line notes for Elementary Number Theory (MATH 3120) on [Supplement. Fermat’s Last Theorem—History](#) gives a slightly different account of the destruction of the Library (in part, because in those notes the so-called “daughter library” of these notes seems to be considered part of the Library of Alexandria). Two scholarly references on which much of the Wikipedia webpage on the decline of the Library is based are:

1. Lionel Casson, *Libraries in the Ancient World* (New Haven, Connecticut: Yale University Press, 2001).
2. Roy MacLeod, “Introduction: Alexandria in History and Myth,” in MacLeod, Roy (ed.), *The Library of Alexandria: Centre of Learning in the Ancient World* (NY and London: I.B.Tauris Publishers, 2000), pp. 118.

Note 6.1.G. As an example of some misleading claims concerning the destruction of the Library of Alexander, we turn to Carl Sagan’s *COSMOS* (NY: Random House, 1980). It pains your instructor to turn to this source for anything misleading, due to the great impact this work (and the corresponding television series) had on him in his formative years. Sagan makes the following statements in the book:

“The classical civilization that created them disintegrated, and the library itself was deliberately destroyed. Only a small fraction of its works survived, along with a few pathetic scattered fragments [page 20]. . . . When, at long last, the mob came to burn the Library down, there was nobody to stop them [page 335]. . . . The glory of the Alexandrian Library is a dim memory. Its last remnants were destroyed soon after Hypatia’s death [in 415 CE; page 336].”

It is arguable as to whether the Library was “deliberately” destroyed. It was to a large extent a victim of poor funding and neglect (perhaps a common method of destruction of institutions by governments even today), which could be deliberate. However, the burning by a “mob” does not seem to be supported by the surviving documentation (and the 415 CE date for destruction of the remnants seems questionable).



The Great Hall of the Library as reconstructed for the 1980 television series *COSMOS: A Personal Voyage* hosted by Carl Sagan. The figure on the left is Alexander the Great and the figure on the right is the god Serapis. From [CrystalLinks.com](https://www.crystalinks.com) (left). Another image from *COSMOS* showing the scrolls on the shelves of the Library, from [Pinterest](https://www.pinterest.com) (right; both websites accessed 8/25/2023).

Note. For some upbeat news, in 1974 Alexandria University chose a plot for its new library on the Mediterranean. The idea was put forward to revive the Alexandrian Library. Construction began in 1995 and the new “Bibliotheca Alexandrina” opened in 2002. The library has line presence is at the [Bibliotheca Alexandrina website](#). It has shelf space for eight-million books, the main reading room is 220,000 square feet on eleven cascading floors. There are four museums, four art galleries, a planetarium, and a manuscript restoration lab. **The Library of Alexandria is back!!!**



Image of the Bibliotheca Alexandrina from the [CairoScene.com webpage](#) (accessed 8/25/2023).

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