

Math 105 History of Mathematics Second Test

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Problem 1. On geometry. [20] Consider the construction given in the *Sulvasutras* for constructing a square equal to the difference of two squares: Let $ABCD$ be the larger square with side equal to a , and let $PQRS$ be the smaller square with side equal to b . Cut off $AK = b$ from AB and draw KL perpendicular to AK intersecting DC in L . With K as center and radius KL , draw an arc meeting AD at M . Then the square on AM is the required square.

Prove that the square on AM equals the difference of the squares $ABCD$ minus $PQRS$.

Problem 2. On simultaneous linear congruences. [25] Solve problem I.1 from the *Shushu jiuzhang*. Find the smallest positive integer N so that the four congruences are all satisfied.

$$N \equiv 1 \pmod{1} \tag{1}$$

$$N \equiv 1 \pmod{2} \tag{2}$$

$$N \equiv 3 \pmod{3} \tag{3}$$

$$N \equiv 1 \pmod{4} \tag{4}$$

Either show your work, or explain how you found the answer.

Problem 3. TRUE/FALSE statements. [30] For each of the following statements write the whole word “true” or the whole word “false”. (If it is unclear whether a statement should be declared true or false, explain your reservations.)

a. In the ninth century Al-Mamun established at Baghdad a “House of Wisdom” (Bait al-hikma) comparable to the ancient Museum at Alexandria.

b. The *Chou Pei Suan Ching* is the Chinese equivalent of Euclid’s *Elements* and includes axioms, postulates, theorems, and proofs in a style very close to Euclid’s.

- c. The parallel postulate was proven to be independent of the rest of Euclidean geometry by the Arabic geometer al-Khwarizmi.
- d. Aryabhata, an Indian mathematician, expressed his mathematics in verse.
- e. The Merton theorem of kinematics (also known as the mean speed rule) states that a body moving with constant acceleration will traverse the same distance as a body moving uniformly at its mean speed.
- f. The problem of “finding 1” studied by the Chinese (and others) is finding the solution x to the congruence $ax \equiv 1 \pmod{b}$ when a and b are relatively prime numbers.
- g. Oresme’s developed a version of fundamental theorem of calculus that said that if a perpendicular whose length is proportional to the velocity at each instant of a time line, then the area of the resulting region is proportional to the distance travelled.
- h. Negative numbers were accepted in China and India long before they were accepted by the Europeans.
- i. Although plane trigonometry was well known in ancient Greece and among the Islamic scholars, spherical trigonometry was not known until Western Europeans discovered it after the 13th century.
- j. Omar Khayyam gave geometric solutions to the fourteen kinds of cubic equations. (Fourteen kinds were needed since he did not consider negative numbers as coefficients.)

Problem 4. Essay. [25] Pick up the essay question when you hand in the test. You’ll write the essay as a take-home part of the test and hand it in at the beginning of the next meeting.